LOGARITHMIC REDUCTION TABLES

MOORE

F. N. Guild.

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FOR STUDENTS OF ANALYTICAL CHEMISTRY

BY

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TO
THE MEMORY OF
MY DEVOTED MOTHER
THIS LITTLE VOLUME
IS DEDICATED

PREFACE

These tables are intended primarily for students of analytical chemistry. My aim has been to produce a book adapted to the needs of the beginner, and, at the same time, to arrange the material in such a way that it may be *conveniently* used by advanced students and chemists.

In discussing logarithms I realize I have encroached on foreign territory, but, in my experience as a teacher, I have known many students who were unfamiliar with the use of logarithms, and who were unwilling to acquaint themselves with the subject unless it be presented as a part of their present work. The subject is important for any one to know who has many arithmetical computations to make, and I hope that a sufficient number will profit by the explanations to justify me in including them.

The tables contain the most recent trustworthy values to be found in the literature. These values and their logarithms have been checked three times in order to eliminate possible errors.

I have used freely Landolt-Börnstein's Physikalisch-chemische Tabellen, Ostwald-Luther's Physiko-chemische Messungen, and many original articles.

C. J. MOORE

Cambridge, Massachusetts

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LOGARITHMIC REDUCTION TABLES

THE ATOMIC WEIGHTS OF THE ELEMENTS AND THEIR LOGARITHMS

	Symbol	Atomic weight	Logarithm
Aluminum	Al	27.1	.432 969
Antimony	Sb	119.86	.078 674
Argon	A	39.9	.600 973
Arsenic	As	74.95	.874 772
Barium	Ba	137.36	.137 860
Bismuth	Bi	208.0	.318 063
Boron	B	11.0	.041 393
Bromine	Br	79.909	.902 596
Cadmium	Cd	112.41	.050 805
Cæsium	Cs	132.80	.123 198
Calcium	Ca	40.07	.602 819
Carbon	C	12.00	.079 181
Cerium	Ce	140.24	.146 872
Chlorine	Cl	35.454	.549 665
Chromium	Cr	52.00	.716 003
Cobalt	Co	58.96	.770 557
Columbium	Cb	93.5	.970 812
Copper	Cu	63.57	.803 252
Dysprosium	Dy	162.5	.210 853
Erbium	Er	167.4	.223 755
Europium	Eu	152.0	.181 844
Fluorine	F	19.0	.278 754
Gadolium	Gd	157.3	.196 729
Gallium	Ga	69.9	.844 477
Germanium	Ge	72.5	.860 338
Glucinum	Gl	9.1	.959 041
Gold	Au	197.2	.294 907
Helium	He	4.0	.602 060
Hydrogen	H	1.0078	.003 375
Indium	In	114.8	.059 942
Iodine	I	126.91	.103 496
Iridium	Ir	193.1	.285 782
Iron	Fe	55.83	.746 868
Krypton	Kr	81.8	.912 753
Lanthanum	La	139.0	.143 015
Lead	Pb	207.07	.316 117
Lithium	Li	6.939	.841 297
Lutecium	Lu	174.0	.240 549
Magnesium	Mg	24.32	.385 964
Manganese	Mn	54.92	.739 731

	Symbol	Atomic weight	Logarithm
Mercury	Hg	200.61	.302 353
Molybdenum	Mo	96.0	.982 271
Neodymium	Nd	144.26	.159 146
Neon	Ne	20.0	.301 030
Nickel	Ni	58.67	.768 416
Nitrogen	N	14.01	.146 438
Osmium	Os	190.9	.280 806
Oxygen	O	16.000	.204 120
Palladium	Pd	106.7	.028 164
Phosphorus	P	31.03	.491 782
Platinum	Pt	195.0	.290 035
Potassium	K	39.091	.592 077
Praseodymium	Pr	140.6	.147 985
Radium	Ra	225.95	.354 012
Rhodium	Rh	102.9	.002 415
Rubidium	Rb	85.44	.931 661
Ruthenium	Ru	101.7	.007 321
Samarium	Sa	150.4	.177 248
Scandium	Sc	44.1	.644 439
Selenium	Se	79.2	.898 725
Silicon	Si	28.3	.451 786
Silver	Ag	107.87	.032 901
Sodium	Na	22.993	.361 595
Strontium	Sr	87.613	.942 569
Sulphur	S	32.07	.506 099
Tantalum	Ta	181.5	.258 877
Tellurium	Te	127.5	.105 510
Terbium	Tb	159.2	.201 943
Thallium	Tl	204.0	.309 630
Thorium	Th	232.40	.366 236
Thulium	Tu	168.5	.226 600
Tin	Sn	119.0	.075 547
Titanium	Ti	48.1	.682 145
Tungsten	W	184.0	.264 818
Uranium	U	238.40	.377 306
Vanadium	V	51.2	.709 270
Xenon	Xe	128.0	.107 210
Ytterbium	Yb	172.0	.235 528
Yttrium	Y	89.0	.949 390
Zinc	Zn	65.36	.815 312
Zirconium	Zr	90.6	.957 128

SECOND TO SEVENTH MULTIPLES OF THE ATOMIC WEIGHTS OF COMMON ELEMENTS AND THEIR LOGARITHMS

	2	log	3	log	4	log
Aluminum	54.2	733 999	81.3	910 090	108.4	035 029
Antimony	239.72	379 704	359.58	555 796	479.44	680 734
Arsenic	149.90	175 802	224.85	351 892	299.80	476 832
Barium	274.72	438 890	412.08	614 982	549.44	739 920
Bismuth	416.0	619 093	624.0	795 185	832.0	920 123
Boron	22.0	342 423	33.0	518 514	44.0	643 453
Bromine	159.818	203 626	239.727	379 717	319.636	504 656
Cadmium	224.82	351 835	337.23	527 927	449.64	652 865
Calcium	80.14	903 849	120.21	079 941	160.28	204 879
Carbon	24.00	380 211	36.00	556 303	48.00	681 241
Chlorine	70.908	850·695	106.362	026 787	141.816	151 725
Chromium	104.00	017 033	156.00	193 125	208.00	318 063
Cobalt	117.92	071 588	176.88	247 679	235.84	372 618
Copper	127.14	104 282	190.71	280 374	254.28	405 312
Fluorine	38.0	579 784	57.0	755 875	76.0	880 814
Gold	394.4	595 937	591.6	772 028	788.8	896 967
Hydrogen	2.0156	304 405	3.0234	480 496	4.0312	605 434
Iodine	253.82	404 526	380.73	580 617	507.64	705 556
Iron	111.66	047 898	167.49	223 989	223.32	348 928
Lead	414.14	617 147	621.21	793 238	828.28	918 177
Lithium	13.878	142 327	20.817	318 418	27.756	443 357
Magnesium	48.64	686 994	72.96	863 085	97.28	988 024
Manganese	109.84	040 760	164.76	216 852	219.68	341 790
Mercury	401.22	603 383	601.83	779 474	802.44	904 413
Molybdenum	192.0	283 301	288.0	459 392	384.0	584 331
Nickel	117.34	069 446	176.01	245 537	234.68	370 476
Nitrogen	28.02	447 468	42.03	623 559	56.04	748 498
Oxygen	32.000	505 150	48.000	681 241	64.000	806 181
Phosphorus	62.06	792 812	93.09	968 903	124.12	093 842
Platinum	390.0	591 065	585.0	767 156	780.0	892 095
Potassium	78.182	893 107	117.273	069 198	156.364	194 137
Silicon	56.6	752 816	84.9	928 908	113.2	053 846
Silver	215.74	333 930	323.61	510 022	431.48	634 961
Sodium	45.986	662 626	68.979	838 717	91.972	963 655
Strontium	175.226	243 598	262.839	419 690	350.452	544 628
Sulphur	64.14	807 129	96.21	983 220	128.28	108 159
Tin	238.0	376 577	357.0	552 668	476.0	677 607
Titanium	96.2	983 175	144.3	159 266	192.4	284 205
Tungsten	368.0	565 848	552.0	741 939	736.0	866 878
Uranium	476.8	678 336	715.2	854 428	953.6	979 366
Zinc	130.72	116 343	196 08	292 433	261.44	417 372

	5	log	6	log	7	log
Aluminum	135.5	131 939	162.6	211 121	189.7	278 067
Antimony	599.30	777 644	719.16	856 826	839.02	923 772
Arsenic	374.75	573 742	449.70	652 923	524.65	719 869
Barium	686.80	836 830	824.16	916 012	961.52	982 958
Bismuth	1040.0	017 033	1248.0	096 215	1456.0	163 161
Boron	55.0	740 363	66.0	819 544	77.0	886 491
Bromine	399.545	601 566	479.454	680 747	559.363	747 694
Cadmium	562.05	749 775	674.46	828 956	786.87	895 903
Calcium	200.35	301 789	240.42	380 971	280.49	447 917
Carbon	60.00	778 151	72.00	857 333	84.00	924 279
Chlorine	177.270	248 635	212.724	327 816	248.178	394 763
Chromium	260.00	414 973	312.00	494 155	364.00	561 101
Cobalt	294.80	469 528	353.76	548 709	412.72	615 656
Copper	317.85	502 222	381.42	581 404	444.99	648 350
Fluorine	95.0	977 724	114.0	056 905	133.0	123 852
Gold	986.0	993 877	1183.2	073 058	1380.4	140 005
Hydrogen	5.0390	702 344	6.0468	781 526	7.0546	848 472
Iodine	634.55	802 466	761.46	881 647	888.37	948 594
Iron	279.15	445 838	334.98	525 019	390.81	591 966
Lead	1035.35	015 087	1242.42	094 269	1449.49	161 215
Lithium	34.695	540 267	41.634	619 448	48.573	686 395
Magnesium	121.60	084 934	145.92	164 115	170.24	231 062
Manganese	274.60	438 701	329.52	517 881	384.44	584 828
Mercury	1003.05	001 323	1203.66	080 504	1404.27	147 451
Molybdenum	480.0	681 241	576.0	760 422	672.0	827 369
Nickel	293.35	467 386	352.02	546 567	410.69	613 514
Nitrogen	70.05	845 408	84.06	924 589	98.07	991 536
Oxygen	80.000	903 090	96.000	982 271	112.000	049 218
Phosphorus	155.15	190 752	186.18	269 933	217.21	336 880
Platinum	975.0	989 005	1170.0	068 186	1365.0	135 133
Potassium	195.455	291 047	234.546	370 228	273.637	437 175
Silicon	141.5	150 756	169.8	229 938	198.1	296 884
Silver	539.35	731 870	647.22	811 052	755.09	877 998
Sodium	114.965	060 566	137.958	139 747	160.951	206 694
Strontium	438.065	641 538	525.678	720 720	613.291	787 667
Sulphur	160.35	205 069	192.42	284 250	224.49	351 197
Tin	595.0	774 517	714.0	853 698	833.0	920 645
Titanium	240.5	381 115	288.6	460 296	336.7	527 243
Tungsten	920.0	963 788	1104.0	042 969	1288.0	109 916
Uranium	1192.0	076 276	1430.4	155 457	1668.8	222 404
Zinc	326.80	514 282	392.16	593 463	457.52	660 410

MOLECULAR WEIGHTS OF COMMON COMPOUNDS AND THEIR LOGARITHMS

	Mol. wt.	log		Mol. wt.	log
$AgBr$	187.779	273 647	CrO_3	100.00	000 000
$AgCN$	133.88	126 716	CrO_4	116.00	064 458
$AgCl$	143.324	156 319	Cu_2O	143.14	155 761
AgI	234.78	370 661	CuO	79.57	900 749
$AgNO_3$	169.88	230 142	Cu_2S	159.21	201 970
Al_2O_3	102.2	009 451	CuS	95.64	980 640
$Al_2(SO_4)_3 \cdot 18\,H_2O$	666.69	823 924	$CuSO_4$	159.64	203 142
As_2O_3	197.90	296 446	$CuSO_4 \cdot 5\,H_2O$	249.72	397 453
As_2O_5	229.90	361 539	$FeCO_3$	115.83	063 821
AsO_3	122.95	089 729	$FeCl_2 \cdot 4\,H_2O$	198.80	298 416
AsO_4	138.95	142 859	$FeCl_3$	162.19	210 024
As_2S_3	246.11	391 130	FeO	71.83	856 306
As_2S_5	310.25	491 712	Fe_2O_3	159.66	203 196
B_2O_3	70.0	845 098	$FePO_4$	150.86	178 574
$BaCO_3$	197.36	295 259	FeS	87.90	943 939
$BaCl_2$	208.27	318 627	$FeSO_4$	151.90	181 558
$BaCl_2 \cdot 2\,H_2O$	244.30	387 923	$FeSO_4 \cdot 7\,H_2O$	278.01	444 060
$BaCrO_4$	253.36	403 738	H_3BO_3	62.0	792 392
$Ba(NO_3)_2$	261.38	417 273	HBr	80.917	908 040
BaO	153.36	185 712	$HCHO_2$	46.02	662 947
$Ba(OH)_2 \cdot 8\,H_2O$	315.50	498 999	$HC_2H_3O_2$	60.03	778 368
$BaSO_4$	233.43	368 157	$H_2C_2O_4$	90.02	954 339
$BaSiF_6$	279.66	446 630	$H_2C_2O_4 \cdot 2\,H_2O$	126.05	100 543
Bi_2O_3	464.0	666 518	$H_2C_4H_4O_6$	150.05	176 236
Bi_2S_3	512.2	709 440	$H_3C_6H_5O_7 \cdot H_2O$	210.08	322 323
CO_2	44.00	643 453	HCl	36.462	561 840
C_2O_4	88.00	944 483	$HClO_4$	100.462	002 002
CO_3	60.00	778 151	$H_2Cr_2O_7$	218.02	338 496
$CaCO_3$	100.07	000 304	H_2CrO_4	118.02	071 956
$CaCl_2$	110.98	045 245	HF	20.0	301 030
$CaCl_2 \cdot 6\,H_2O$	219.07	340 583	HI	127.918	106 932
CaO	56.07	748 731	HNO_3	63.02	799 478
$CaSO_4$	136.14	133 986	H_2O	18.0156	255 649
$CaSO_4 \cdot 2\,H_2O$	172.17	235 958	H_2O_2	34.0156	531 678
CdO	128.41	108 599	H_3PO_4	98.05	991 448
CdS	144.48	159 808	H_2PtCl_6	409.7	612 466
$CdSO_4$	208.48	319 064	H_2S	34.09	532 627
CoO	74.96	874 830	H_2SO_3	82.09	914 290
$CoSO_4$	155.03	190 416	H_2SO_4	98.09	991 625
$CoSO_4 \cdot 7\,H_2O$	281.14	448 923	Hg_2Cl_2	472.13	674 062
Cr_2O_3	152.00	181 844	$HgCl_2$	271.52	433 802

	Mol. wt.	log		Mol. wt.	log
$KAl(SO_4)_2 \cdot 12\,H_2O$	474.5	676 236	NH_4Cl	53.50	728 354
$KAlSi_3O_8$	279.1	445 760	$(NH_4)_2Fe(SO_4)_2 \cdot 6\,H_2O$	392.14	593 441
KBr	119.000	075 547	$NH_4Fe(SO_4)_2 \cdot 12\,H_2O$	482.19	683 218
KCN	65.10	813 581	NH_4OH	35.05	544 688
K_2CO_3	138.13	140 288	$(NH_4)_3PO_4(MoO_3)_{12}$	1877.2	273 511
KCl	74.545	872 419	$(NH_4)_2PtCl_6$	443.8	647 187
$KClO_3$	122.545	088 296	$(NH_4)_2SO_4$	132.15	121 067
$KClO_4$	138.545	141 591	$NaAlSi_3O_8$	263.0	419 956
$K_3Co(NO_2)_6$	452.29	655 417	$Na_2B_4O_7$	202.0	305 351
K_2CrO_4	194.18	288 205	$Na_2B_4O_7 \cdot 10\,H_2O$	382.1	582 177
$K_2Cr_2O_7$	294.18	468 613	$NaBr$	102.902	012 424
$KCr(SO_4)_2 \cdot 12\,H_2O$	499.42	698 466	$NaC_2H_3O_2 \cdot 3\,H_2O$	136.06	133 730
$K_3Fe(CN)_6$	329.15	517 394	Na_2CO_3	105.99	025 265
$K_4Fe(CN)_6$	368.24	566 131	$Na_2CO_3 \cdot 10\,H_2O$	286.14	456 579
KI	166.001	220 111	$NaCl$	58.447	766 762
KIO_3	214.001	330 416	$Na_2Cr_2O_7 \cdot 2\,H_2O$	298.02	474 245
$KMnO_4$	158.01	198 685	$NaHCO_3$	84.00	924 279
KNO_2	85.10	929 930	$Na_2HPO_4 \cdot 12\,H_2O$	358.24	554 174
KNO_3	101.10	004 751	$NaHSO_4$	120.07	079 435
$KNaC_4H_4O_6 \cdot 4\,H_2O$	282.18	450 526	$NaNO_2$	69.00	838 849
K_2O	94.182	973 968	$NaNO_3$	85.00	929 419
KOH	56.099	748 955	Na_2O	61.986	792 294
K_2PtCl_6	485.9	686 547	Na_2O_2	77.986	892 017
K_2SO_4	174.25	241 173	$NaOH$	40.00	602 060
$MgCO_3$	84.32	925 931	$Na_2S_2O_3 \cdot 5\,H_2O$	248.20	394 802
$MgCl_2 \cdot 6\,H_2O$	203.32	308 180	$Na_2SO_3 \cdot 7\,H_2O$	252.17	401 693
MgO	40.32	605 521	Na_2SO_4	142.06	152 472
$Mg_2P_2O_7$	222.70	347 720	$Na_2SO_4 \cdot 10\,H_2O$	322.21	508 139
$MgSO_4$	120.39	080 590	NiO	74.67	873 146
$MgSO_4 \cdot 7\,H_2O$	246.50	391 817	$NiSO_4$	154.74	189 603
$MnCO_3$	114.92	060 396	$NiSO_4 \cdot 7\,H_2O$	280.85	448 474
MnO	70.92	850 769	NO_3	62.01	792 462
Mn_2O_3	157.84	198 217	PCl_3	137.39	137 955
Mn_3O_4	228.76	359 380	PBr_3	270.76	432 585
MnO_2	86.92	939 120	P_2O_3	110.06	041 630
$Mn_2P_2O_7$	283.90	453 165	P_2O_5	142.06	152 472
MnS	86.99	939 469	PO_4	95.03	977 861
$MnSO_4$	150.99	178 948	$PbCO_3$	267.07	426 625
$MnSO_4 \cdot 4\,H_2O$	223.05	348 402	$PbCl_2$	277.98	444 014
NH_3	17.03	231 215	$PbCrO_4$	323.07	509 297
NH_4	18.04	256 237	$Pb(NO_3)_2$	331.09	519 946
$(NH_4)_2C_2O_4 \cdot H_2O$	142.10	152 594	PbO	223.07	348 441

	Mol. wt.	log		Mol. wt.	log
PbS	239.14	378 652	SnO	135.0	130 334
$PbSO_4$	303.14	481 643	SnO_2	151.0	178 977
$PtCl_4$	336.8	527 372	$SrCO_3$	147.61	169 116
SO_2	64.07	806 655	$Sr(NO_3)_2$	211.63	325 577
SO_3	80.07	903 470	SrO	103.613	015 414
SO_4	96.07	982 588	$Sr(OH)_2 \cdot 8\,H_2O$	265.754	424 480
SiO_2	60.3	780 317	$SrSO_4$	183.68	264 062
SiO_3	76.3	882 525	$ZnCO_3$	125.36	098 159
SiO_4	92.3	965 202	ZnO	81.36	910 411
$SnCl_2$	189.9	278 525	ZnS	97.43	988 693
$SnCl_2 \cdot 2\,H_2O$	225.9	353 916	$ZnSO_4 \cdot 7\,H_2O$	287.54	458 698
$SnCl_4$	260.8	416 308			

SECOND TO FIFTH MULTIPLES OF THE MOLECULAR WEIGHTS OF SOME COMMON COMPOUNDS AND OF THE WEIGHTS OF A FEW RADICALS TOGETHER WITH THEIR LOGARITHMS

	2	log	3	log	4	log	5	log
AgBr	375.558	574 677	563.337	750 768	751.116	875 707	938.895	972 617
AgCl	286.648	457 349	429.972	633 440	573.296	758 379	716.620	855 289
AgI	469.56	671 691	704.34	847 782	939.12	922 721	1173.90	069 631
Al_2O_3	204.4	310 481	306.6	486 572	408.8	611 511	511.0	708 421
$Ba(OH)_2$	342.75	534 977	514.13	711 073	685.50	836 007	856.88	932 920
$Ba(OH)_2 \cdot 8H_2O$	631.00	800 029	946.50	976 121	1262.00	101 059	1577.5	197 969
CO_2	88.00	944 483	132.00	120 574	176.00	245 513	220.00	342 423
CO_3	120.00	079 181	180.00	255 273	240.00	380 211	300.00	477 121
CaO	112.14	049 761	168.21	225 852	224.28	350 791	280.35	447 701
Cr_2O_3	304.00	482 874	456.00	658 965	608.00	783 904	760.00	880 814
CuO	159.14	201 779	238.71	377 871	318.28	502 809	397.85	599 719
FeO	143.64	157 275	215.46	333 367	287.28	458 305	359.10	555 215
Fe_2O_3	319.28	504 172	478.92	680 263	638.56	805 202	798.20	902 112
$HCHO_2$	92.03	963 929	138.05	140 036	184.06	264 959	230.10	361 917
$HC_2H_3O_2$	120.06	079 398	180.09	255 490	240.13	380 446	300.15	477 338
$H_2C_2O_4$	180.03	255 345	270.05	431 444	360.06	556 375	450.10	653 309
$H_2C_2O_4 \cdot 2H_2O$	252.09	401 556	378.14	577 653	504.19	702 594	630.25	799 513
$H_2C_4H_4O_6$	300.09	477 251	450.14	653 348	600.19	778 289	750.25	875 206
$H_3C_6H_5O_7 \cdot H_2O$	420.16	623 415	630.23	799 499	840.31	924 440	1050.2	021 293
HCl	72.924	862 870	109.385	038 958	145.847	163 898	182.31	260 810
HNO_3	126.04	100 508	189.05	276 577	252.07	401 521	315.10	498 448
H_2O	36.0312	556 700	54.0468	732 828	72.0614	857 724	90.0780	954 619
H_2SO_4	196.17	292 633	294.26	468 731	392.34	593 663	490.45	690 595
K_2O	188.364	274 998	282.546	451 089	376.728	576 028	470.910	672 938
KOH	112.198	049 985	168.296	226 074	224.395	351 013	280.49	447 925
MgO	80.64	906 551	120.96	082 642	161.28	207 581	201.60	304 491
NH_3	34.07	532 372	51.10	708 421	68.13	833 338	85.15	930 185
NH_4	36.08	557 267	54.12	733 358	72.16	858 297	92.30	965 207
NH_4OH	70.1	845 718	105.15	021 809	140.20	146 748	175.25	243 658
NO_3	124.02	093 492	186.03	269 583	248.04	394 522	310.05	491 432
Na_2CO_3	211.97	326 274	317.96	502 372	423.94	627 304	529.95	724 235
NaOH	80.002	903 100	120.002	079 188	160.003	204 128	200.00	301 030
OH	34.0156	531 678	51.0234	707 769	68.0312	832 708	85.039	929 618
PO_4	190.06	278 891	285.09	454 982	380.12	579 921	475.15	676 831
P_2O_5	284.12	453 502	426.18	629 593	568.24	754 532	710.30	851 442
SO_2	128.14	107 685	192.21	283 776	256.28	408 715	320.35	505 625
SO_3	160.14	204 500	240.21	380 591	320.28	505 530	400.35	602 440
SO_4	192.14	283 618	288.21	459 709	384.28	584 648	480.35	681 558
SiO_2	120.6	081 347	180.9	257 439	241.2	382 377	301.5	479 287
SiO_3	152.6	183 555	228.9	359 646	305.2	484 585	381.5	581 495
SiO_4	184.6	266 232	276.9	442 323	369.2	567 262	461.5	664 172

REDUCTION OF COMPOUNDS FOUND TO CONSTITUENTS SOUGHT BY MULTIPLICATION

Sought	Found	*Factor*	log
Ag	AgBr	.57 445	759 254
	AgCl	.75 263	876 582
Al	Al_2O_3	.53 033	724 548
As	As_2O_3	.75 745	879 356
	As_2O_5	.65 202	814 263
	As_2S_3	.60 908	784 672
	As_2S_5	.48 316	684 090
	$MgNH_4AsO_4 \cdot H_2O$	.37 601	575 200
	$Mg_2As_2O_7$	.48 270	683 684
As_2O_3	As_2O_5	.86 081	934 907
	As_2S_3	.80 411	905 316
	As_2S_5	.63 787	804 734
	$MgNH_4AsO_4 \cdot H_2O$	.49 641	695 844
	$Mg_2As_2O_7$	.63 728	804 328
As_2O_5	As_2S_3	.93 413	970 409
AsO_3	As_2S_3	.99 914	999 629
AsO_4	As_2S_3	1.12 917	052 759
Ba	BaO	.89 568	952 148
	$BaCO_3$	.69 599	842 601
	$BaCrO_4$	.54 213	734 103
	$BaSO_4$	.58 844	769 703
	$BaSiF_6$	.49 117	691 230
BaO	$BaCO_3$	.77 706	890 453
	$BaSO_4$	.65 698	817 555
Bi	Bi_2O_3	.89 655	952 575
	Bi_2S_3	.81 217	909 645
B	B_2O_3	.31 428	497 325
	KBF_4	.08 723	940 666
Br	AgBr	.42 555	628 949
C	CO_2	.27 273	435 728
CO_2	$CaCO_3$	.43 969	643 149
	CaO	.78 473	894 722
	MgO	1.09 127	037 932
CO_3	CO_2	1.36 363	134 698
Ca	$CaCO_3$	.40 042	602 515
	CaO	.71 464	854 088
	$CaSO_4$	.29 433	468 833
$CaCO_3$	CaO	1.78 473	251 573
	$CaSO_4$	.73 505	866 318
CaO	CO_2	1.27 432	105 278

Sought	Found	*Factor*	log
CaO	$CaCO_3$	.56 031	748 427
	$CaSO_4$	.41 186	614 745
Cd	CdO	.87 540	942 206
	CdS	.77 803	890 997
	$CdSO_4$	.53 919	731 741
CdO	CdS	.88 877	948 791
	$CdSO_4$	.61 593	789 535
Cl	Ag	.32 867	516 764
Cl	$AgCl$	.24 737	393 346
Co	CoO	.78 655	895 727
	$CoSO_4$	.38 031	580 141
	$2\,CoSO_4 \cdot 3\,K_2SO_4$	.14 159	151 041
	$2\,CoK_3(NO_2)_6 \cdot 3\,H_2O$	.12 300	089 922
CoO	Co	1.27 137	104 273
	$CoSO_4$	.48 352	684 414
	$2\,CoSO_4 \cdot 3\,K_2SO_4$	.18 002	255 314
	$2\,CoSO_4K_3(NO_2)_6 \cdot 3\,H_2O$	.15 638	194 195
Cr	$BaCrO_4$	.20 524	312 265
	Cr_2O_3	.68 421	835 189
	$PbCrO_4$	.16 096	206 706
Cr_2O_3	$BaCrO_4$	.29 997	477 076
	$PbCrO_4$	.23 524	371 517
CrO_3	$BaCrO_4$	.39 470	596 262
	Cr_2O_3	1.31 579	119 186
	$PbCrO_4$	.30 953	490 703
CrO_4	$BaCrO_4$	.45 784	660 710
	Cr_2O_3	1.52 631	183 644
	$PbCrO_4$	.35 905	555 161
Cu	CuO	.79 892	902 503
	CuS	.79 857	902 312
CuO	Cu	1.25 169	097 497
	Cu_2S	.99 956	999 809
F	CaF_2	.48 662	687 189
	SiF_4	.72 866	862 530
Fe	Fe_2O_3	.69 932	844 678
	FeS	.63 511	802 851
FeO	Fe	1.28 663	109 455
	Fe_2O_3	.89 977	954 133
Fe_2O_3	Fe	1.42 995	155 322
H	H_2O	.11 188	048 756
HBr	$AgBr$	.43 092	634 393
HCl	$AgCl$	.25 440	405 521

Sought	Found	*Factor*	log
HI	AgI	.54 484	736 271
HNO_3	NH_4Cl	1.17 794	071 124
	$(NH_4)_2PtCl_6$	.28 400	453 321
	Pt	.64 635	810 473
H_2SO_4	$BaSO_4$	.42 021	623 468
Hg	Hg_2Cl_2	.84 981	929 321
	HgS	.86 217	935 594
Hg_2O	Hg	1.03 988	016 982
HgO	Hg	1.07 976	033 326
I	AgI	.54 055	732 835
	PdI_2	.70 408	847 621
K	KCl	.52 439	719 658
	K_2PtCl_6	.16 090	206 560
K	Pt	.40 093	603 072
	K_2SO_4	.44 868	651 934
KCl	K_2PtCl_6	.30 683	486 902
	Pt	.76 457	883 414
K_2O	KCl	.63 171	800 519
	KNO_3	.46 579	668 187
	K_2PtCl_6	.19 383	287 421
	Pt	.48 298	683 933
	K_2SO_4	.54 050	732 795
K_2SO_4	$BaSO_4$	.74 648	873 016
Li	Li_2O	.46 449	666 975
	Li_2CO_3	.18 784	273 800
	Li_3PO_4	.17 967	254 483
	Li_2SO_4	.12 622	101 131
Li_2O	Li_2CO_3	.40 441	606 825
	Li_3PO_4	.38 682	587 506
	Li_2SO_4	.27 174	434 156
Mg	MgO	.60 317	780 443
	$Mg_2P_2O_7$	.21 839	339 235
$MgCO_3$	MgO	2.09 127	320 410
	$Mg_2P_2O_7$	.75 718	879 199
MgO	$Mg_2P_2O_7$	.36 207	558 792
Mn	MnO	.77 439	888 962
	Mn_2O_3	.69 590	842 544
	Mn_3O_4	.72 023	857 472
	$Mn_2P_2O_7$	.38 690	587 596
	MnS	.63 134	800 262
	$MnSO_4$	.36 373	560 783
MnO	MnS	.81 527	911 300

Sought	Found	*Factor*	log
MnO	$MnSO_4$	.46 970	671 821
N	NH_3	.82 266	915 223
	$(NH_4)_2PtCl_6$	.06 314	800 281
	Pt	.14 369	157 433
NH_3	N	1.21 556	084 777
	NH_4Cl	.31 832	502 861
	$(NH_4)_2PtCl_6$	.07 675	885 058
	Pt	.17 466	242 210
NH_4	NH_4Cl	.33 720	527 883
	$(NH_4)_2PtCl_6$	.08 130	910 080
NO_3	NH_4Cl	1.15 907	064 108
	$(NH_4)_2PtCl_6$	.27 945	446 305
	Pt	.63 600	803 457
Na	Na_2O	.74 187	870 331
	NaCl	.39 340	594 833
	$NaNO_3$	.27 051	432 176
	Na_2SO_4	.32 371	510 153
NaCl	Na_2SO_4	.82 285	915 320
Na_2O	NaCl	.53 028	724 502
	$NaNO_3$	.36 462	561 845
	Na_2SO_4	.43 634	639 822
Na_2SO_4	$BaSO_4$	.60 858	784 315
Ni	NiO	.78 572	895 270
NiO	Ni	1.27 271	104 730
P	P_2O_5	.43 686	640 340
	$Mg_2P_2O_7$	.27 867	445 092
	$(NH_4)_3PO_4 \cdot 12\,MoO_3$	.01 653	218 271
P_2O_5	Ag_3PO_4	.16 967	229 601
	$Mg_2P_2O_7$	.63 790	804 752
	$(NH_4)_3PO_4 \cdot 12\,MoO_3$	.03 784	577 931
	$(UO_2)_2P_2O_7$	.19 872	298 251
PO_4	$Mg_2P_2O_7$	.85 344	931 171
	$(NH_4)_2PO_4 \cdot 12\,MoO_3$	.05 062	704 350
Pb	$PbCrO_4$	.64 094	806 820
	PbO	.92 827	967 676
	PbO_2	.86 615	937 592
	PbS	.86 589	937 465
	$PbSO_4$	.68 309	834 474
PbO	$PbCrO_4$	.69 047	839 144
	PbS	.93 280	969 789
	$PbSO_4$	.73 586	866 798
PbS	$PbSO_4$	.78 888	897 009

Sought	Found	*Factor*	log
Pt	NaCl	1.65 818	222 243
S	$BaSO_4$	.13 738	137 942
	As_2S_3	.39 092	592 090
SO_3	$BaSO_4$	.34 302	535 313
SO_4	$BaSO_4$	.41 156	614 431
Sb	Sb_2O_3	.83 317	920 734
	Sb_2O_4	.78 928	897 230
	Sb_2S_3	.71 360	853 455
	Sb_2S_5	.59 919	777 568
Sb_2O_3	Sb_2O_4	.94 732	976 496
	Sb_2S_3	.85 649	932 721
	Sb_2S_5	.71 917	856 834
Si	SiO_2	.46 932	671 469
SiO_3	SiO_2	1.26 534	102 208
SiO_4	SiO_2	1.53 068	184 885
Si_2O_7	SiO_2	1.39 800	145 510
Sn	SnO_2	.78 808	896 570
SnO	SnO_2	.89 404	951 357
Sr	$SrCO_3$	.59 354	773 453
	SrO	.84 558	927 155
	$SrSO_4$	.47 699	678 507
SrO	$SrCO_3$	.70 194	846 298
	$SrSO_4$	.56 409	751 352
Ti	TiO_2	.60 050	778 512
U	UO_2	.88 166	945 299
	U_3O_8	.84 820	928 497
W	WO_3	.79 310	899 330
Zn	ZnO	.80 334	904 901
	ZnS	.67 084	826 619
ZnO	ZnS	.83 506	921 718
ZnS	ZnO	1.19 752	078 282

REDUCTION OF BAROMETRIC READINGS TO 0°

(For temperatures above zero the corrections are negative and for temperatures below zero positive.)

Temperature	Glass Scale					Brass Scale				
	740 mm.	750 mm.	760 mm.	770 mm.	780 mm.	740 mm.	750 mm.	760 mm.	770 mm.	780 mm.
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1°	13	13	13	13	14	12	12	12	13	13
2°	26	26	26	27	27	24	25	25	25	25
3°	38	39	39	40	41	36	37	37	38	38
4°	51	52	53	53	54	48	49	50	50	51
5°	0.64	0.65	0.66	0.67	0.68	0.60	0.61	0.62	0.63	0.64
6°	77	78	79	80	81	72	73	74	75	76
7°	0.90	0.91	0.92	0.93	0.95	85	86	0.87	0.88	0.89
8°	1.02	1.04	1.05	1.07	1.08	0.97	0.98	1.99	1.01	1.02
9°	15	17	18	20	21	1.09	1.10	12	13	15
10°	1.28	1.30	1.31	1.33	1.35	1.21	1.22	1.24	1.26	1.27
11°	41	43	45	46	48	33	35	36	38	40
12°	53	56	58	60	62	45	47	49	51	53
13°	66	69	71	73	75	57	59	61	63	65
14°	79	81	84	1.86	1.89	69	71	73	76	78
15°	1.92	1.94	1.97	2.00	2.02	1.81	1.83	1.86	1.88	1.91
16°	2.05	2.07	2.10	13	16	1.93	1.96	1.98	2.01	2.03
17°	17	20	23	26	29	2.05	2.08	2.10	13	16
18°	30	33	36	39	43	17	20	23	26	29
19°	43	46	49	53	56	29	32	35	38	41
20°	2.56	2.59	2.62	2.66	2.69	2.41	2.44	2.47	2.51	2.54
21°	68	72	76	79	83	53	56	60	63	67
22°	81	85	2.89	2.92	2.96	65	69	72	76	79
23°	2.94	2.98	3.02	3.06	3.10	77	81	84	2.88	2.92
24°	3.06	3.11	15	19	23	2.89	2.93	2.97	3.01	3.05
25°	3.19	3.23	3.28	3.32	3.36	3.01	3.05	3.09	3.13	3.17
26°	32	36	41	45	50	13	17	21	26	30
27°	45	49	54	59	63	25	29	34	38	42
28°	57	62	67	72	77	37	41	46	51	55
29°	70	75	80	85	3.90	49	54	58	63	68
30°	3.83	3.88	3.93	3.98	4.03	3.61	3.66	3.71	3.75	3.80
31°	3.95	4.01	4.06	4.11	17	73	78	83	3.88	3.93
32°	4.08	14	19	25	30	85	3.90	3.95	4.00	4.05
33°	21	26	32	38	43	3.97	4.02	4.07	13	18
34°	33	39	45	51	57	4.09	14	20	25	31
35°	4.46	4.52	4.58	4.65	4.71	4.21	4.26	4.32	4.38	4.43

GEOGRAPHICAL LATITUDE, ELEVATION, AND GRAVITY (REFERRED TO 45° AND SEA LEVEL) OF SOME IMPORTANT CITIES

	Latitude	Height above sea level m.	Gravity	log
Baltimore, Met.	39° 18′	23.	0.9 994 705	999 770
Berlin, New Obs.	52° 30′ 16.7″	37.00	1.0 006 736	000 292
Bonn, Obs.	50° 43′ 45.0″	61.92	1.0 005 054	000 219
Boston, Met.	42° 21′	38.	0.9 997 438	999 889
Brüssels, Old Obs.	50° 51′ 10.7″	56.	1.0 005 179	000 225
Cambridge, Eng., Obs.	52° 12′ 51.6″	28.	1.0 006 504	000 282
Cambridge, Mass., Harvard Obs.	42° 22′ 47.6″	24.	0.9 997 509	999 892
Cincinnati, Obs.	39° 8′ 19.5″	263.	0.9 993 803	999 731
Dublin, Dunsink Obs.	53° 23′ 13.1″	86.	1.0 007 365	000 320
Freiberg	47° 59′ 40″	270.6	1.0 001 907	000 083
Göttingen, Obs.	51° 31′ 48.2″	159.2	1.0 005 478	000 238
Greenwich, Obs.	51° 28′ 38.1″	47.	1.0 005 783	000 251
Heidelberg, Obs.	49° 23′ 54.9″	113.6	1.0 003 688	000 160
Kopenhagen, Obs.	55° 41′ 12.9″	14.	1.0 009 602	000 317
London, Camden Sq., Met.	51° 32′ 30″	34.	1.0 005 881	000 255
Madrid, Obs.	45° 27′ 59.2″	120.	1.0 000 053	000 002
Montreal, McGill Col. Obs.	45° 30′ 17.0″	57.	1.0 000 287	000 012
New Haven, Yale Obs.	41° 19′ 22.3″	32.	0.9 996 521	999 848
New Orleans, Met.	29° 58′	16.	0.9 986 721	999 423
New York, Rutherford Obs.	40° 43′ 48.5″	96.	0.9 995 774	999 817
Paris, Nat. Obs.	48° 50′ 11.2″	59.	1.0 003 345	000 145
Philadelphia, Obs.	39° 57′ 7.5″	36.	0.9 995 254	999 794
Prag, Obs.	50° 5′ 15.8″	197.	1.0 004 053	000 176
Quebec, Obs.	46° 48′ 20.8″	70.	1.0 001 446	000 063
St. Louis, Obs.	38° 38′ 3.6″	171.	0.9 993 611	999 722
San Francisco, Davidson Obs.	37° 47′ 28.0″	47.2	0.9 993 272	999 708
Strassburg, New Obs.	48° 35′ 0.3″	144.66	1.0 002 845	000 124
Washington, Georgetown Hts. Obs.	38° 55′ 14.7″	285.	0.9 993 537	999 719
Zürich, Obs. d. Polyt.	47° 22′ 40″	468.24	1.0 000 718	000 031

TABLE VIII

REDUCTION OF BAROMETRIC READINGS TO NORMAL GRAVITY

(From Landolt-Börnstein)

A. Reduction to 45° Latitude

(From 0° to 45° the correction is always negative, and from 45° to 90° positive.)

Latitude	Barometric Readings in mm., corrected for Temperature															Latitude
	640 *mm.*	650 *mm.*	660 *mm.*	670 *mm.*	680 *mm.*	690 *mm.*	700 *mm.*	710 *mm.*	720 *mm.*	730 *mm.*	740 *mm.*	750 *mm.*	760 *mm.*	770 *mm.*	780 *mm.*	
0°	1.66	1.68	1.71	1.74	1.76	1.79	1.81	1.84	1.86	1.89	1.92	1.94	1.97	1.99	2.02	90°
5°	63	66	68	71	73	76	79	81	84	86	89	91	94	96	1.99	85°
10°	56	58	61	63	65	68	70	73	75	78	80	83	85	87	90	80°
15°	44	46	48	50	53	55	57	59	61	64	66	68	70	73	75	75°
20°	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	70°
25°	1.07	1.08	1.10	1.12	1.13	1.15	1.17	1.18	1.20	1.22	1.23	1.25	1.27	28	30	65°
30°	0.83	0.84	0.85	0.87	0.88	0.89	0.91	0.92	0.93	0.95	0.96	0.97	0.98	1.00	1.01	60°
35°	57	58	58	59	60	61	62	63	64	65	66	66	67	0.68	0.69	55°
40°	29	29	30	30	31	31	31	32	32	33	33	34	34	35	35	50°
45°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45°

B. Reduction to Sea Level

(These corrections are all negative.)

Height above sea level *m.*	Barometric Readings in mm., corrected for Temperature									Height above sea level *m.*
	620 *mm.*	640 *mm.*	660 *mm.*	680 *mm.*	700 *mm.*	720 *mm.*	740 *mm.*	760 *mm.*	780 *mm.*	
100					0.01	0.01	0.01	0.01	0.02	100
200				0.03	03	03	03	03	0.03	200
300				04	04	04	04	04		300
400			0.05	05	05	06	06	06		400
500			06	07	07	07	07	0.07		500
600			08	08	08	08	09			600
700		0.09	09	09	10	10	10			700
800		10	10	11	11	11	0.12			800
900		0.11	0.12	0.12	0.12	0.13				900
1000	0.12	0.13	0.13	0.13	0.14	0.14				1000
1100	13	14	14	15	15	0.16				1100
1200	15	15	16	16	16					1200
1300	16	16	17	17	18					1300
1400	17	18	18	19	0.19					1400
1500	18	19	19	20						1500
1600	19	20	21	21						1600
1700	21	21	22	0.23						1700
1800	22	23	23							1800
1900	0.23	0.24	0.25							1900
2000	0.24	0.25								2000

CAPILLARY DEPRESSION OF MERCURY

(Interpolated by F. Kohlrausch from Mendelejeff and Gutkowsky.)

	Height of Meniscus in mm.							
Diameter of tube	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*
4	0.83	1.22	1.54	1.98	2.37			
5	47	0.65	0.86	1.19	1.45	1.80		
6	27	41	56	0.78	0.98	1.21	1.43	
7	18	28	40	53	67	0.82	0.97	1.13
8		20	29	38	46	56	65	0.77
9		15	21	28	33	40	46	52
10			15	20	25	29	33	37
11			10	14	18	21	24	27
12			07	10	13	15	18	19
13			04	07	10	12	13	14

TABLE X

TENSION OF AQUEOUS VAPOR OVER WATER—EXPRESSED IN TERMS OF NORMAL MERCURY UNITS

(Taken from Landolt-Börnstein. Observations by Regnault.)

Degrees	Hydrogen Scale. Tenth Degrees									
	.0 mm.	.1 mm.	.2 mm.	.3 mm.	.4 mm.	.5 mm.	.6 mm.	.7 mm.	.8 mm.	.9 mm.
0	4.579	4.612	4.646	4.679	4.713	4.747	4.782	4.816	4.851	4.886
1	4.921	4.957	4.992	5.028	5.064	5.101	5.137	5.174	5.211	5.248
2	5.286	5.324	5.362	5.400	5.438	5.477	5.516	5.555	5.595	5.635
3	5.675	5.715	5.755	5.796	5.837	5.878	5.920	5.961	6.003	6.046
4	6.088	6.131	6.174	6.217	6.261	6.305	6.349	6.393	6.438	6.483
5	6.528	6.574	6.620	6.666	6.712	6.759	6.806	6.853	6.901	6.949
6	6.997	7.045	7.094	7.143	7.192	7.242	7.292	7.342	7.392	7.443
7	7.494	7.546	7.598	7.650	7.702	7.755	7.808	7.861	7.914	7.968
8	8.023	8.077	8.132	8.187	8.243	8.299	8.355	8.412	8.469	8.526
9	8.584	8.642	8.700	8.759	8.818	8.877	8.937	8.997	9.057	9.118
10	9.179	9.240	9.302	9.364	9.427	9.490	9.553	9.616	9.680	9.745
11	9.810	9.875	9.940	10.006	10.072	10.139	10.206	10.274	10.342	10.410
12	10.479	10.548	10.617	10.687	10.757	10.828	10.899	10.970	11.042	11.114
13	11.187	11.260	11.333	11.407	11.481	11.556	11.631	11.706	11.782	11.859
14	11.936	12.013	12.091	12.169	12.247	12.326	12.406	12.486	12.566	12.647
15	12.728	12.810	12.892	12.974	13.057	13.141	13.225	13.309	13.394	13.480
16	13.565	13.651	13.738	13.825	13.913	14.001	14.090	14.179	14.269	14.359
17	14.450	14.541	14.632	14.724	14.817	14.910	15.003	15.097	15.192	15.287
18	15.383	15.479	15.575	15.672	15.770	15.868	15.967	16.066	16.166	16.266
19	16.367	16.469	16.571	16.673	16.776	16.880	16.984	17.088	17.193	17.299
20	17.406	17.513	17.620	17.728	17.837	17.947	18.057	18.167	18.278	18.390
21	18.503	18.616	18.729	18.844	18.959	19.074	19.190	19.307	19.424	19.542
22	19.661	19.780	19.900	20.021	20.142	20.264	20.386	20.510	20.634	20.758
23	20.883	21.010	21.137	21.264	21.393	21.522	21.652	21.782	21.913	22.045
24	22.178	22.311	22.446	22.581	22.716	22.853	22.990	23.128	23.266	23.406
25	23.546	23.686	23.828	23.970	24.113	24.257	24.401	24.547	24.693	24.839
26	24.987	25.135	25.284	25.434	25.584	25.736	25.888	26.041	26.195	26.349
27	26.505	26.661	26.818	26.976	27.134	27.294	27.454	27.615	27.777	27.939
28	28.103	28.267	28.432	28.599	28.766	28.933	29.102	29.271	29.442	29.613
29	29.785	29.958	30.132	30.307	30.482	30.659	30.836	31.015	31.194	31.374
30	31.555	31.737	31.919	32.103	32.288	32.473	32.660	32.847	33.036	33.225
31	33.416	33.607	33.799	33.992	34.187	34.382	34.578	34.775	34.973	35.172
32	35.372	35.573	35.775	35.978	36.182	36.387	36.593	36.800	37.008	37.217
33	37.427	37.638	37.851	38.064	38.278	38.493	38.710	38.927	39.146	39.365
34	39.586	39.807	40.030	40.254	40.479	40.705	40.933	41.161	41.390	41.621
35	41.853	42.085	42.319	42.554	42.791	43.028	43.266	43.506	43.747	43.989

REDUCTION OF WATER PRESSURE TO MERCURY PRESSURE

(Calculated from the following: temperature of the water 4°, of the mercury 0°; density of the water 1, of the mercury 13.59545)

(Thiesen and Schul. Z. S. f. Instrk. 18, 138)

Water	Mercury	Water	Mercury	Water	Mercury	Water	Mercury	Water	Mercury
10	0.74	50	3.68	90	6.62	130	9.56	170	12.50
11	81	51	75	91	69	131	64	171	58
12	88	52	82	92	77	132	71	172	65
13	0.96	53	90	93	84	133	78	173	72
14	1.03	54	3.97	94	91	134	86	174	80
15	10	55	4.05	95	6.99	135	9.93	175	87
16	18	56	12	96	7.06	136	10.00	176	12.95
17	25	57	19	97	13	137	08	177	13.02
18	32	58	27	98	21	138	15	178	09
19	40	59	34	99	28	139	22	179	17
20	1.47	60	4.41	100	7.36	140	10.30	180	13.24
21	54	61	49	101	43	141	37	181	31
22	62	62	56	102	50	142	44	182	38
23	69	63	63	103	58	143	52	183	46
24	77	64	71	104	65	144	59	184	53
25	84	65	78	105	72	145	67	185	61
26	91	66	85	106	80	146	74	186	68
27	1.99	67	4.93	107	87	147	81	187	75
28	2.06	68	5.00	108	7.94	148	89	188	83
29	13	69	08	109	8.02	149	10.96	189	90
30	2.21	70	5.15	110	8.09	150	11.03	190	13.98
31	28	71	22	111	16	151	11	191	14.05
32	35	72	30	112	24	152	18	192	12
33	43	73	37	113	31	153	25	193	20
34	50	74	44	114	39	154	33	194	27
35	57	75	52	115	46	155	40	195	34
36	65	76	59	116	53	156	47	196	42
37	72	77	66	117	61	157	55	197	49
38	79	78	74	118	68	158	62	198	56
39	87	79	81	119	75	159	69	199	64
40	2.94	80	5.88	120	8.83	160	11.77	200	14.71
41	3.02	81	5.96	121	90	161	84	300	22.07
42	09	82	6.03	122	8.97	162	92	400	29.42
43	16	83	10	123	9.05	163	11.99	500	36.78
44	24	84	18	124	12	164	12.06	600	44.13
45	31	85	25	125	19	165	14	700	51.49
46	38	86	33	126	27	166	21	800	58.84
47	46	87	40	127	34	167	28	900	66.20
48	53	88	47	128	41	168	36	1000	73.55
49	60	89	55	129	49	169	43		

REDUCTION OF THE VOLUME OF GASES TO NORMAL PRESSURE

(This table contains the values of $\frac{h}{760}$ where h = 500 to 839 mm.)

(Landolt-Börnstein)

h mm.	$\frac{h}{760}$	$\log \frac{h}{760}$	h mm.	$\frac{h}{760}$	$\log \frac{h}{760}$	h mm.	$\frac{h}{760}$	$\log \frac{h}{760}$
500	0.65 789	818 153	**540**	0.71 053	851 582	**580**	0.76 316	882 616
501	0.65 921	9 024	**541**	184	2 382	**581**	447	3 360
502	0.66 053	819 893	**542**	316	3 187	**582**	579	4 110
503	184	820 753	**543**	447	3 984	**583**	711	4 858
504	316	1 618	**544**	579	4 786	**584**	842	5 599
505	447	2 475	**545**	711	5 586	**585**	0.76 974	6 344
506	579	3 337	**546**	842	6 378	**586**	0.77 105	7 083
507	711	4 198	**547**	0.71 974	7 176	**587**	237	7 825
508	842	5 049	**548**	0.72 105	7 965	**588**	368	8 561
509	0.66 974	5 906	**549**	237	8 760	**589**	500	889 302
510	0.67 105	826 755	**550**	0.72 368	859 547	**590**	0.77 632	890 041
511	237	7 608	**551**	500	860 338	**591**	763	0 773
512	368	8 454	**552**	632	1 128	**592**	0.77 895	1 510
513	500	829 304	**553**	763	1 911	**593**	0.78 026	1 682
514	632	830 152	**554**	0.72 895	2 698	**594**	158	2 973
515	763	0 993	**555**	0.73 026	3 478	**595**	289	3 701
516	0.67 895	1 838	**556**	158	4 262	**596**	421	4 432
517	0.68 026	2 675	**557**	289	5 039	**597**	553	5 163
518	158	3 517	**558**	421	5 820	**598**	684	5 886
519	289	4 351	**559**	553	6 600	**599**	816	6 614
520	0.68 421	835 189	**560**	0.73 684	867 373	**600**	0.78 947	897 336
521	553	6 027	**561**	816	8 151	**601**	0.79 079	8 061
522	684	6 856	**562**	0.73 947	8 921	**602**	211	8 786
523	816	7 689	**563**	0.74 079	869 695	**603**	342	899 503
524	0.68 947	8 515	**564**	211	870 468	**604**	474	900 225
525	0.69 079	839 346	**565**	342	1 234	**605**	605	0 940
526	211	840 175	**566**	474	2 005	**606**	737	1 660
527	342	0 996	**567**	605	2 768	**607**	0.79 868	2 373
528	474	1 822	**568**	737	3 536	**608**	0.80 000	3 090
529	605	2 640	**569**	0.74 868	4 296	**609**	132	3 806
530	0.69 737	843 463	**570**	0.75 000	875 061	**610**	0.80 263	904 515
531	0.69 868	4 278	**571**	132	5 825	**611**	395	5 229
532	0.70 000	5 098	**572**	263	6 582	**612**	526	5 936
533	132	5 916	**573**	395	7 343	**613**	658	6 647
534	263	6 727	**574**	526	8 097	**614**	789	7 352
535	395	7 542	**575**	658	8 855	**615**	0.80 921	8 061
536	526	8 349	**576**	789	879 606	**616**	0.81 053	8 769
537	658	9 161	**577**	0.75 921	880 362	**617**	184	909 470
538	789	849 966	**578**	0.76 053	1 116	**618**	316	910 176
539	921	850 775	**579**	184	1 864	**619**	447	0 875

h mm.	h/760	log h/760	h mm.	h/760	log h/760	h mm.	h/760	log h/760
620	0.81 579	911 578	660	0.86 842	938 730	700	0.92 105	964 283
621	711	2 281	661	0.86 974	939 389	701	237	4 905
622	842	2 976	662	0.87 105	940 043	702	368	5 522
623	0.81 974	3 676	663	237	0 701	703	500	6 142
624	0.82 105	4 370	664	368	1 352	704	632	6 761
625	237	5 067	665	500	2 008	705	763	7 375
626	368	5 759	666	632	2 663	706	0.92 895	7 992
627	500	6 454	667	763	3 312	707	0.93 026	8 604
628	632	7 148	668	0.87 895	3 964	708	158	9 220
629	763	7 836	669	0.88 026	4 611	709	289	969 830
630	0.82 895	918 528	670	0.88 158	945 262	710	0.93 421	970 445
631	0.83 026	9 214	671	289	5 907	711	553	1 058
632	158	919 904	672	421	6 555	712	684	1 665
633	289	920 588	673	553	7 203	713	816	2 277
634	421	1 275	674	684	7 845	714	0.93 947	2 883
635	553	1 962	675	816	8 491	715	0.94 079	3 493
636	684	2 642	676	0.88 947	9 131	716	211	4 102
637	816	3 327	677	0.89 079	949 775	717	342	4 705
638	0.83 947	4 005	678	211	950 418	718	474	5 312
639	0.84 079	4 688	679	342	1 056	719	605	5 914
640	0.84 211	925 369	680	0.89 474	951 697	720	0.94 737	976 520
641	342	6 044	681	605	2 332	721	0.94 868	7 120
642	474	6 723	682	737	2 972	722	0.95 000	7 724
643	605	7 396	683	0.89 868	3 605	723	132	8 327
644	737	8 073	684	0.90 000	4 243	724	263	8 924
645	0.84 868	8 744	685	132	4 879	725	394	979 521
646	0.85 000	929 419	686	263	5 510	726	526	980 122
647	132	930 093	687	395	6 144	727	658	0 721
648	263	0 761	688	526	6 773	728	789	1 316
649	395	1 432	689	658	7 406	729	0.95 921	1 914
650	0.85 526	932 098	690	0.90 789	958 033	730	0.96 053	982 511
651	658	2 768	691	0.90 921	8 664	731	184	3 103
652	790	3 437	692	0.91 053	9 294	732	316	3 698
653	0.85 921	4 099	693	184	959 919	733	447	4 289
654	0.86 053	4 766	694	316	960 547	734	579	4 883
655	184	5 427	695	447	1 170	735	710	5 471
656	316	6 091	696	579	1 796	736	842	6 064
657	447	6 750	697	711	2 421	737	0.96 974	6 655
658	579	7 413	698	842	3 041	738	0.97 105	7 242
659	711	8 074	699	974	3 665	739	237	7 832

h mm.	$\frac{h}{760}$	$\log\frac{h}{760}$	h mm.	$\frac{h}{760}$	$\log\frac{h}{760}$	h mm.	$\frac{h}{760}$	$\log\frac{h}{760}$
740	0.97 368	988 416	**780**	1.02 632	011 283	**820**	1.07 895	033 001
741	500	9 005	**781**	763	1 837	**821**	1.08 026	3 529
742	632	989 592	**782**	1.02 895	2 394	**822**	158	4 059
743	763	990 175	**783**	1.03 026	2 947	**823**	289	4 584
744	0.97 895	0 761	**784**	158	3 504	**824**	421	5 113
745	0.98 026	1 341	**785**	289	4 054	**825**	553	5 642
746	158	1 926	**786**	421	4 609	**826**	684	6 166
747	289	2 505	**787**	553	5 163	**827**	816	6 693
748	421	3 088	**788**	684	5 712	**828**	1.08 947	7 215
749	553	3 670	**789**	816	6 264	**829**	1.09 079	7 741
750	0.98 684	994 247	**790**	1.03 947	016 812	**830**	1.09 211	038 267
751	816	4 827	**791**	1.04 079	7 363	**831**	342	8 787
752	0.98 947	5 403	**792**	211	7 914	**832**	471	9 299
753	0.99 079	5 982	**793**	342	8 459	**833**	605	039 831
754	211	6 560	**794**	474	9 008	**834**	737	040 353
755	342	7 133	**795**	605	019 552	**835**	1.09 868	0 871
756	474	7 710	**796**	737	020 100	**836**	1.10 000	1 393
757	605	8 281	**797**	1.04 868	0 643	**837**	132	1 913
758	737	8 856	**798**	1.05 000	1 189	**838**	263	2 430
759	0.99 868	999 426	**799**	132	1 735	**839**	395	2 949
760	1.00 000	000 000	**800**	1.05 263	022 276			
761	1.00 132	0 573	**801**	395	2 820			
762	263	1 141	**802**	526	3 359			
763	392	1 699	**803**	658	3 902			
764	526	2 278	**804**	789	4 441			
765	658	2 848	**805**	1.05 921	4 982			
766	789	3 413	**806**	1.06 053	5 523			
767	1.00 921	3 982	**807**	184	6 059			
768	1.01 053	4 549	**808**	316	6 598			
769	184	5 112	**809**	447	7 134			
770	1.01 316	005 678	**810**	1.06 579	027 672			
771	447	6 239	**811**	711	8 209			
772	579	6 804	**812**	842	8 742			
773	710	7 364	**813**	1.06 974	9 278			
774	842	7 927	**814**	1.07 105	029 809			
775	1.01 974	8 489	**815**	237	030 345			
776	1.02 105	9 047	**816**	368	0 875			
777	237	009 608	**817**	500	1 408			
778	368	010 164	**818**	632	1 941			
779	500	0 724	**819**	763	2 470			

REDUCTION OF THE VOLUME OF GASES TO 0° C.

This table contains the logarithms of the values of $\frac{1}{1 + 0.003670\,t}$ where $t = 0$ to 149°.

t	log	t	log	t	log	t	log
0.0	000 000	4.0	993 671	8.0	987 433	12.0	981 284
0.1	999 839	4.1	3 513	8.1	7 277	12.1	1 130
0.2	9 683	4.2	3 359	8.2	7 125	12.2	0 980
0.3	9 523	4.3	3 200	8.3	6 969	12.3	0 826
0.4	9 362	4.4	3 042	8.4	6 813	12.4	0 672
0.5	9 202	4.5	2 884	8.5	6 657	12.5	0 518
0.6	9 045	4.6	2 730	8.6	6 505	12.6	0 368
0.7	8 885	4.7	2 572	8.7	6 350	12.7	0 215
0.8	8 725	4.8	2 414	8.8	6 194	12.8	980 062
0.9	8 569	4.9	2 260	8.9	6 043	12.9	979 912
1.0	998 409	5.0	992 103	9.0	985 888	13.0	979 759
1.1	8 249	5.1	1 945	9.1	5 732	13.1	9 606
1.2	8 093	5.2	1 792	9.2	5 581	13.2	9 457
1.3	7 934	5.3	1 634	9.3	5 425	13.3	9 304
1.4	7 774	5.4	1 477	9.4	5 270	13.4	9 150
1.5	7 618	5.5	1 323	9.5	5 119	13.5	9 002
1.6	7 458	5.6	1 166	9.6	4 963	13.6	8 848
1.7	7 304	5.7	1 008	9.7	4 808	13.7	8 695
1.8	7 137	5.8	0 850	9.8	4 653	13.8	8 542
1.9	6 984	5.9	0 697	9.9	4 502	13.9	8 393
2.0	996 824	6.0	990 540	10.0	984 347	14.0	978 240
2.1	6 664	6.1	0 383	10.1	4 192	14.1	8 087
2.2	6 509	6.2	0 231	10.2	4 041	14.2	7 938
2.3	6 350	6.3	990 073	10.3	3 887	14.3	7 786
2.4	6 191	6.4	989 916	10.4	3 732	14.4	7 634
2.5	6 032	6.5	9 759	10.5	3 577	14.5	7 481
2.6	5 877	6.6	9 607	10.6	3 426	14.6	7 333
2.7	5 718	6.7	9 450	10.7	3 271	14.7	7 180
2.8	5 559	6.8	9 293	10.8	3 117	14.8	7 028
2.9	5 404	6.9	9 141	10.9	2 967	14.9	6 880
3.0	995 244	7.0	988 983	11.0	982 813	15.0	976 727
3.1	5 086	7.1	8 828	11.1	2 658	15.1	6 575
3.2	4 931	7.2	8 675	11.2	2 507	15.2	6 427
3.3	4 772	7.3	8 519	11.3	2 353	15.3	6 274
3.4	4 614	7.4	8 362	11.4	2 199	15.4	6 122
3.5	4 459	7.5	8 210	11.5	2 049	15.5	5 974
3.6	4 301	7.6	8 054	11.6	1 895	15.6	5 822
3.7	4 142	7.7	7 897	11.7	1 741	15.7	5 665
3.8	3 984	7.8	7 741	11.8	1 587	15.8	5 517
3.9	3 829	7.9	7 588	11.9	1 437	15.9	5 370

t	log	t	log	t	log	t	log
16.0	975 229	20.0	969 238	24.0	963 339	28.0	957 519
16.1	5 067	20.1	9 089	24.1	3 192	28.1	7 373
16.2	4 919	20.2	8 943	24.2	3 048	28.2	7 236
16.3	4 768	20.3	8 794	24.3	2 900	28.3	7 095
16.4	4 616	20.4	8 644	24.4	2 753	28.4	6 941
16.5	4 465	20.5	8 495	24.5	2 606	28.5	6 795
16.6	4 318	20.6	8 350	24.6	2 462	28.6	6 654
16.7	4 166	20.7	8 200	24.7	2 315	28.7	6 508
16.8	4 015	20.8	8 051	24.8	2 167	28.8	6 363
16.9	3 867	20.9	7 905	24.9	2 024	28.9	6 221
17.0	973 717	21.0	967 756	25.0	961 876	29.0	956 076
17.1	3 565	21.1	7 606	25.1	1 729	29.1	5 931
17.2	3 418	21.2	7 461	25.2	1 586	29.2	5 789
17.3	3 267	21.3	7 313	25.3	1 440	29.3	5 644
17.4	3 116	21.4	7 164	25.4	1 293	29.4	5 499
17.5	2 968	21.5	7 019	25.5	1 150	29.5	5 358
17.6	2 817	21.6	6 870	25.6	1 003	29.6	5 213
17.7	2 666	21.7	6 721	25.7	0 856	29.7	5 068
17.8	2 516	21.8	6 572	25.8	0 709	29.8	4 923
17.9	2 369	21.9	6 427	25.9	0 566	29.9	4 783
18.0	972 219	22.0	966 279	26.0	960 419	30.0	954 638
18.1	2 068	22.1	6 130	26.1	0 272	30.1	4 493
18.2	1 922	22.2	5 986	26.2	960 130	30.2	4 353
18.3	1 771	22.3	5 837	26.3	959 983	30.3	4 208
18.4	1 620	22.4	5 689	26.4	9 837	30.4	4 063
18.5	1 470	22.5	5 541	26.5	9 690	30.5	3 918
18.6	1 323	22.6	5 396	26.6	9 548	30.6	3 778
18.7	1 173	22.7	5 248	26.7	9 402	30.7	3 634
18.8	1 022	22.8	5 099	26.8	9 255	30.8	3 489
18.9	0 876	22.9	4 955	26.9	9 113	30.9	3 349
19.0	970 726	23.0	964 807	27.0	958 966	31.0	953 205
19.1	0 575	23.1	4 658	27.1	8 820	31.1	3 060
19.2	0 430	23.2	4 514	27.2	8 678	31.2	2 920
19.3	0 280	23.3	4 366	27.3	8 532	31.3	2 776
19.4	970 130	23.4	4 218	27.4	8 387	31.4	2 632
19.5	969 981	23.5	4 074	27.5	8 245	31.5	2 492
19.6	9 829	23.6	3 926	27.6	8 099	31.6	2 348
19 7	9 682	23.7	3 778	27.7	7 953	31.7	2 204
19.8	9 534	23.8	3 630	27.8	7 806	31.8	2 060
19.9	9 388	23.9	3 487	27.9	7 664	31.9	1 920

t	log	t	log	t	log	t	log
32.0	951 776	**35**	947 518	**70**	900 700	**110**	852 726
32.1	1 632	**36**	6 114	**71**	899 433	**111**	1 592
32.2	1 492	**37**	4 702	**72**	8 170	**112**	850 461
32.3	1 349	**38**	3 303	**73**	6 912	**113**	849 333
32.4	1 205	**39**	1 905	**74**	5 656	**114**	8 208
32.5	1 061			**75**	4 405	**115**	7 085
32.6	0 922			**76**	3 156	**116**	5 965
32.7	0 778			**77**	1 912	**117**	4 849
32.8	0 635			**78**	0 671	**118**	3 736
32.9	0 495			**79**	889 434	**119**	2 625
33.0	950 351	**40**	940 513	**80**	888 200	**120**	841 517
33.1	0 208	**41**	939 125	**81**	6 970	**121**	840 412
33.2	950 069	**42**	7 741	**82**	5 743	**122**	839 309
33.3	949 926	**43**	6 363	**83**	4 519	**123**	8 210
33.4	9 783	**44**	4 988	**84**	3 299	**124**	7 113
33.5	9 643	**45**	3 618	**85**	2 083	**125**	6 019
33.6	9 500	**46**	2 252	**86**	880 869	**126**	4 928
33.7	9 358	**47**	930 891	**87**	879 660	**127**	3 839
33.8	9 215	**48**	9 534	**88**	8 453	**128**	2 754
33.9	9 075	**49**	8 181	**89**	7 250	**129**	1 671
34.0	948 932	**50**	926 832	**90**	876 050	**130**	830 591
		51	5 487	**91**	4 854	**131**	829 513
		52	4 147	**92**	3 661	**132**	8 438
		53	2 810	**93**	2 471	**133**	7 365
		54	1 478	**94**	1 284	**134**	6 295
		55	920 150	**95**	870 101	**135**	5 228
		56	918 826	**96**	868 920	**136**	4 164
		57	7 506	**97**	7 743	**137**	3 102
		58	6 189	**98**	6 570	**138**	2 043
		59	4 877	**99**	5 399	**139**	820 986
		60	913 569	**100**	864 231	**140**	819 932
		61	2 265	**101**	3 067	**141**	8 880
		62	910 964	**102**	1 906	**142**	7 831
		63	909 668	**103**	860 748	**143**	6 784
		64	8 375	**104**	859 593	**144**	5 741
		65	7 087	**105**	8 441	**145**	4 699
		66	5 801	**106**	7 292	**146**	3 660
		67	4 520	**107**	6 146	**147**	2 623
		68	3 243	**108**	5 003	**148**	1 589
		69	1 969	**109**	3 863	**149**	0 558

REDUCTION OF THE VOLUME OF GASES SATURATED WITH AQUEOUS VAPOR TO 0°, NORMAL PRESSURE, AND DRY

$$V_0 = V \frac{p_0 - h}{(1 + 0.003670\,t)\,760}$$

(V is the volume of the gas, p the uncorrected barometric pressure read on a glass or wooden scale, p_0 barometric pressure corrected for temperature, h the maximum tension of aqueous vapor, t the temperature. This table contains the logarithms of

$$\frac{p_0 - h}{(1 + 0.003670\,t)\,760},$$

where p varies from 730 to 780 and t from 12° to 24°.)

(Landolt-Börnstein)

t	p = 730 log	Difference for 10 mm.	p = 740 log	Difference for 10 mm.	p = 750 log	Difference for 10 mm.	p = 760 log	Difference for 10 mm.	p = 770 log	Difference for 10 mm.	p = 780 log
12.0	95 663	599	96 262	591	96 853	584	97 437	575	98 012	568	98 580
12.2	622	600	222	591	813	583	396	576	97 972	568	540
12.4	582	599	181	592	773	583	356	576	932	568	500
12.6	541	600	141	592	733	583	316	576	892	568	460
12.8	501	599	100	592	692	584	276	576	852	568	420
13.0	95 460	600	96 060	592	96 652	584	97 236	576	97 812	568	98 380
13.2	419	600	96 019	592	611	584	195	576	771	569	340
13.4	378	601	95 979	592	571	584	155	576	731	569	300
13.6	337	601	938	592	530	584	114	577	691	568	259
13.8	296	601	897	592	489	584	073	577	650	569	219
14.0	95 256	600	95 856	592	96 448	585	97 033	576	97 609	570	98 179
14.2	214	601	815	592	407	585	96 992	577	569	569	138
14.4	173	601	774	592	366	585	951	577	528	569	097
14.6	131	601	732	593	325	585	910	577	487	570	057
14.8	090	601	691	593	284	585	869	577	446	570	016
15.0	95 048	602	95 650	593	96 243	585	96 828	577	97 405	570	97 975
15.2	95 007	601	608	593	201	585	786	578	364	570	934
15.4	94 965	601	566	594	160	585	745	578	323	570	893
15.6	923	602	525	593	118	586	704	577	281	570	851
15.8	881	602	483	594	077	585	662	578	240	570	810
16.0	94 839	602	95 441	594	96 035	585	96 620	578	97 198	571	97 769
16.2	797	602	399	594	95 993	586	579	578	157	570	727
16.4	755	602	357	594	951	586	537	578	115	571	686
16.6	712	603	315	594	909	586	495	578	073	571	644
16.8	670	602	272	595	867	586	453	579	032	570	602

t	p = 730 log	Difference for 10 mm.	p = 740 log	Difference for 10 mm.	p = 750 log	Difference for 10 mm.	p = 760 log	Difference for 10 mm.	p = 770 log	Difference for 10 mm.	p = 780 log
17.0	94 627	603	95 230	594	95 824	587	96 411	579	96 990	571	97 561
17.2	585	602	187	595	782	587	369	578	947	572	519
17.4	542	603	145	595	740	586	326	579	905	572	477
17.6	499	603	102	595	697	587	284	579	863	571	434
17.8	456	603	059	595	654	587	241	580	821	571	392
18.0	94 413	603	95 016	596	95 612	587	96 199	579	96 778	572	97 350
18.2	370	603	94 973	596	569	587	156	580	736	571	307
18.4	326	604	930	596	526	587	113	580	693	572	265
18.6	283	604	887	596	483	587	070	580	650	572	222
18.8	239	604	843	596	439	588	027	580	607	573	180
19.0	94 196	604	94 800	596	95 396	588	95 984	580	96 564	573	97 137
19.2	152	604	756	597	353	588	941	580	521	573	094
19.4	108	605	713	596	309	588	897	581	478	573	051
19.6	064	605	669	596	265	589	854	580	434	573	97 007
19.8	020	605	625	596	221	589	810	581	391	573	96 964
20.0	93 975	606	94 581	597	95 178	588	95 766	581	96 347	574	96 921
20.2	931	605	536	597	133	589	722	582	304	573	877
20.4	886	606	492	597	089	589	678	582	260	573	833
20.6	842	606	448	597	045	589	634	582	216	574	790
20.8	797	606	403	598	001	589	590	582	172	574	746
21.0	93 752	606	94 358	598	94 956	590	95 546	581	96 127	575	96 702
21.2	707	606	313	598	911	590	501	582	083	574	657
21.4	662	606	268	598	866	591	457	582	96 039	574	613
21.6	616	607	223	598	821	591	412	582	95 994	575	569
21.8	571	607	178	598	776	591	367	582	949	575	524
22.0	93 525	607	94 132	599	94 731	591	95 322	583	95 905	575	96 480
22.2	479	608	087	599	686	591	277	583	860	575	435
22.4	433	608	94 041	599	640	591	231	583	814	576	390
22.6	387	608	93 995	600	595	591	186	583	769	576	345
22.8	341	608	949	600	549	591	140	584	724	575	299
23.0	93 295	608	93 903	600	94 503	591	95 094	584	95 678	576	96 254
23.2	248	609	857	600	457	592	049	583	632	577	209
23.4	202	608	810	601	411	592	95 003	584	587	576	163
23.6	155	609	764	600	364	592	94 956	585	541	576	117
23.8	108	609	717	601	318	592	910	585	495	576	071
24.0	93 061	609	93 670	601	94 271	593	94 864	584	95 448	577	96 025

OBSERVED DENSITY AND THE WEIGHT OF A LITER OF SOME COMMON GASES UNDER THE FOLLOWING CONDITIONS: 0° AND 760 MM. PRESSURE AT SEA LEVEL AND 45° LATITUDE. AIR = 1

Substance	Density	Wt. 1 liter in grams at sea level and 45° lat.	log	Observer
Acetylene	0.92	1.1620	065 206	Berthelot
Air	1.00	1.2928	111 532	Leduc, Lord Rayleigh (Mean value)
Ammonia	0.5971	0.7621	882 012	Leduc
Argon	1.379	1.782	250 908	Ramsay and Travers
Bromine	5.5243 at 227.92°	7.1426	853 856	Jahn
Carbon dioxide	1.52909	1.9652	293 407	Lord Rayleigh
Carbon monoxide	0.96716	1.2506	097 118	Lord Rayleigh
Chlorine	2.491	3.1666	500 593	Leduc
Ethane	1.075	1.3421	127 785	Kolbe
Ethylene	0.9852	1.2520	097 604	Saussure
Hydrogen	0.06926	0.09004	954 435	Regnault
Hydrogen sulphide	1.1895	1.5230	182 700	Leduc
Hydrobromic acid	2.71	3.6163	558 265	Löwig
Hydrochloric acid	1.2692	1.6283	211 734	Leduc
Hydriodic acid	4.3757	5.7106	756 682	Thomson
Methane	0.5576	0.7160	854 913	Thomson
Methyl ether	1.617	2.0567	313 171	Dumas and Peligot
Nitrogen	0.96737	1.2542	098 367	Lord Rayleigh
Nitrogen dioxide	1.0372	1.3417	127 655	Leduc
Nitrogen monoxide	1.5301	1.9688	294 202	Leduc
Oxygen	1.10535	1.4292	155 093	Lord Rayleigh
Sulphur dioxide	2.2639	2.8611	456 533	Leduc

DENSITY OF DRY ATMOSPHERIC AIR AT 760 MM. PRESSURE AND TEMPERATURES RANGING FROM 0° TO 35°

$$\left(\text{Values of } d_{t,\,760} = \frac{.0012928}{1 + .003670\,t}\right)$$

t	$d_{t,\,760}$	log	t	$d_{t,\,760}$	log	t	$d_{t,\,760}$	log
0.0	0.0 012 928	111 531	4.0	0.0 012 741	105 204	8.0	0.0 012 559	098 955
0.1	12 923	1 363	4.1	12 736	5 033	8.1	12 555	8 817
0.2	12 919	1 229	4.2	12 732	4 897	8.2	12 550	8 644
0.3	12 914	1 061	4.3	12 728	4 760	8.3	12 546	8 505
0.4	12 909	0 893	4.4	12 723	4 590	8.4	12 541	8 332
0.5	12 904	0 724	4.5	12 718	4 419	8.5	12 537	8 194
0.6	12 900	0 590	4.6	12 713	4 248	8.6	12 532	8 020
0.7	12 895	0 421	4.7	12 709	4 111	8.7	12 528	7 882
0.8	12 890	0 253	4.8	12 704	3 941	8.8	12 524	7 743
0.9	12 885	110 084	4.9	12 700	3 804	8.9	12 519	7 570
1.0	0.0 012 881	109 950	5.0	0.0 012 695	103 633	9.0	0.0 012 515	097 431
1.1	12 876	9 781	5.1	12 690	3 462	9.1	12 511	7 292
1.2	12 871	9 612	5.2	12 686	3 325	9.2	12 506	7 118
1.3	12 867	9 477	5.3	12 681	3 154	9.3	12 501	6 945
1.4	12 862	9 309	5.4	12 677	3 017	9.4	12 497	6 806
1.5	12 857	9 140	5.5	12 672	2 845	9.5	12 492	6 632
1.6	12 853	9 005	5.6	12 668	2 708	9.6	12 488	6 493
1.7	12 848	8 836	5.7	12 663	2 537	9.7	12 484	6 354
1.8	12 843	8 667	5.8	12 659	2 399	9.8	12 479	6 180
1.9	12 838	8 497	5.9	12 654	2 228	9.9	12 475	6 041
2.0	0.0 012 834	108 362	6.0	0.0 012 649	102 056	10.0	0.0 012 470	095 867
2.1	12 829	8 193	6.1	12 645	1 919	10.1	12 466	5 727
2.2	12 824	8 024	6.2	12 640	1 747	10.2	12 462	5 588
2.3	12 820	7 888	6.3	12 636	1 610	10.3	12 457	5 414
2.4	12 815	7 719	6.4	12 631	1 438	10.4	12 453	5 274
2.5	12 810	7 549	6.5	12 627	1 300	10.5	12 448	5 100
2.6	12 806	7 414	6.6	12 622	1 128	10.6	12 444	4 960
2.7	12 801	7 244	6.7	12 618	0 991	10.7	12 440	4 820
2.8	12 797	7 108	6.8	12 613	0 818	10.8	12 435	4 646
2.9	12 792	6 939	6.9	12 609	0 681	10.9	12 431	4 506
3.0	0.0 012 787	106 769	7.0	0.0 012 604	100 508	11.0	0.0 012 426	094 331
3.1	12 783	6 633	7.1	12 600	0 371	11.1	12 422	4 192
3.2	12 778	6 463	7.2	12 595	0 198	11.2	12 418	4 052
3.3	12 773	6 293	7.3	12 591	100 060	11.3	12 413	3 877
3.4	12 769	6 157	7.4	12 586	099 888	11.4	12 409	3 737
3.5	12 764	5 987	7.5	12 582	9 750	11.5	12 404	3 562
3.6	12 759	5 817	7.6	12 577	9 577	11.6	12 400	3 422
3.7	12 755	5 681	7.7	12 573	9 439	11.7	12 396	3 282
3.8	12 750	5 510	7.8	12 568	9 266	11.8	12 391	3 106
3.9	12 746	5 374	7.9	12 564	9 128	11.9	12 387	2 966

t	$d_{t, 760}$	log	t	$d_{t, 760}$	log	t	$d_{t, 760}$	log
12.0	0.0 012 383	092 826	**16.0**	0.0 012 211	086 751	**20.0**	0.0 012 044	080 770
12.1	12 378	2 651	**16.1**	12 207	6 609	**20.1**	12 040	0 627
12.2	12 374	2 510	**16.2**	12 203	6 467	**20.2**	12 036	0 482
12.3	12 370	2 370	**16.3**	12 198	6 289	**20.3**	12 032	0 338
12.4	12 365	2 194	**16.4**	12 194	6 146	**20.4**	12 028	0 193
12.5	12 361	2 054	**16.5**	12 190	6 004	**20.5**	12 023	080 013
12.6	12 357	1 913	**16.6**	12 186	5 861	**20.6**	12 019	079 868
12.7	12 352	1 737	**16.7**	12 181	5 683	**20.7**	12 015	9 724
12.8	12 348	1 597	**16.8**	12 177	5 540	**20.8**	12 011	9 579
12.9	12 344	1 456	**16.9**	12 173	5 398	**20.9**	12 007	9 435
13.0	0.0 012 339	091 280	**17.0**	0.0 012 169	085 255	**21.0**	0.0 012 003	079 290
13.1	12 335	1 139	**17.1**	12 165	5 112	**21.1**	11 999	9 145
13.2	12 331	0 998	**17.2**	12 160	4 934	**21.2**	11 995	9 000
13.3	12 326	0 822	**17.3**	12 156	4 791	**21.3**	11 991	8 855
13.4	12 322	0 681	**17.4**	12 152	4 648	**21.4**	11 987	8 711
13.5	12 318	0 540	**17.5**	12 148	4 505	**21.5**	11 982	8 529
13.6	12 313	0 364	**17.6**	12 144	4 362	**21.6**	11 978	8 384
13.7	12 309	0 223	**17.7**	12 139	4 183	**21.7**	11 974	8 239
13.8	12 305	090 082	**17.8**	12 135	4 040	**21.8**	11 970	8 094
13.9	12 301	089 940	**17.9**	12 131	3 897	**21.9**	11 966	7 949
14.0	0.0 012 296	089 764	**18.0**	0.0 012 127	083 753	**22.0**	0.0 011 962	077 804
14.1	12 292	9 623	**18.1**	12 123	3 610	**22.1**	11 958	7 659
14.2	12 288	9 481	**18.2**	12 119	3 467	**22.2**	11 954	7 513
14.3	12 283	9 305	**18.3**	12 114	3 288	**22.3**	11 950	7 368
14.4	12 279	9 163	**18.4**	12 110	3 144	**22.4**	11 946	7 223
14.5	12 275	9 022	**18.5**	12 106	3 001	**22.5**	11 942	7 077
14.6	12 270	8 845	**18.6**	12 102	2 857	**22.6**	11 938	6 932
14.7	12 266	8 703	**18.7**	12 098	2 714	**22.7**	11 934	6 786
14.8	12 262	8 561	**18.8**	12 094	2 570	**22.8**	11 930	6 640
14.9	12 258	8 420	**18.9**	12 089	2 390	**22.9**	11 926	6 495
15.0	0.0 012 253	088 242	**19.0**	0.0 012 085	082 247	**23.0**	0.0 011 922	076 349
15.1	12 249	8 101	**19.1**	12 081	2 103	**23.1**	11 918	6 203
15.2	12 245	7 959	**19.2**	12 077	1 959	**23.2**	11 914	6 058
15.3	12 241	7 817	**19.3**	12 073	1 815	**23.3**	11 910	5 912
15.4	12 236	7 640	**19.4**	12 069	1 671	**23.4**	11 906	5 766
15.5	12 232	7 498	**19.5**	12 065	1 527	**23.5**	11 902	5 620
15.6	12 228	7 355	**19.6**	12 060	1 347	**23.6**	11 898	5 474
15.7	12 224	7 213	**19.7**	12 056	1 203	**23.7**	11 894	5 328
15.8	12 219	7 036	**19.8**	12 052	1 059	**23.8**	11 889	5 145
15.9	12 215	6 894	**19.9**	12 048	0 915	**23.9**	11 885	4 999

t	$d_{t,\,760}$	log	t	$d_{t,\,760}$	log	t	$d_{t,\,760}$	log
24.0	0.0 011 881	074 853	**28.0**	0.0 011 723	069 039	**32.0**	0.0 011 569	063 296
24.1	11 877	4 707	**28.1**	11 719	8 891	**32.1**	11 566	3 183
24.2	11 873	4 561	**28.2**	11 716	8 779	**32.2**	11 562	3 033
24.3	11 869	4 414	**28.3**	11 712	8 631	**32.3**	11 558	2 883
24.4	11 865	4 268	**28.4**	11 708	8 483	**32.4**	11 554	2 732
24.5	11 861	4 121	**28.5**	11 704	8 334	**32.5**	11 550	2 582
24.6	11 857	3 975	**28.6**	11 700	8 186	**32.6**	11 547	2 469
24.7	11 853	3 828	**28.7**	11 696	8 037	**32.7**	11 543	2 319
24.8	11 849	3 682	**28.8**	11 692	7 889	**32.8**	11 539	2 168
24.9	11 846	3 572	**28.9**	11 688	7 740	**32.9**	11 535	2 018
25.0	0.0 011 842	073 425	**29.0**	0.0 011 684	067 592	**33.0**	0.0 011 531	061 867
25.1	11 838	3 278	**29.1**	11 681	7 480	**33.1**	11 528	1 754
25.2	11 834	3 132	**29.2**	11 677	7 331	**33.2**	11 524	1 603
25.3	11 830	2 985	**29.3**	11 673	7 183	**33.3**	11 520	1 453
25.4	11 826	2 838	**29.4**	11 669	7 034	**33.4**	11 516	1 302
25.5	11 822	2 691	**29.5**	11 665	6 885	**33.5**	11 513	1 189
25.6	11 818	2 544	**29.6**	11 661	6 736	**33.6**	11 509	1 038
25.7	11 814	2 397	**29.7**	11 657	6 587	**33.7**	11 505	0 887
25.8	11 810	2 250	**29.8**	11 654	6 475	**33.8**	11 501	0 736
25.9	11 806	2 103	**29.9**	11 650	6 326	**33.9**	11 497	0 585
26.0	0.0 011 802	071 956	**30.0**	0.0 011 646	066 177	**34.0**	0.0 011 494	060 471
26.1	11 798	1 808	**30.1**	11 642	6 028	**34.1**	11 490	0 320
26.2	11 794	1 661	**30.2**	11 638	5 878	**34.2**	11 486	0 169
26.3	11 790	1 514	**30.3**	11 634	5 729	**34.3**	11 483	060 055
26.4	11 786	1 366	**30.4**	11 630	5 580	**34.4**	11 479	059 904
26.5	11 782	1 219	**30.5**	11 627	5 468	**34.5**	11 475	9 753
26.6	11 778	1 072	**30.6**	11 623	5 318	**34.6**	11 471	9 601
26.7	11 774	0 924	**30.7**	11 619	5 169	**34.7**	11 468	9 488
26.8	11 770	0 777	**30.8**	11 615	5 019	**34.8**	11 464	9 336
26.9	11 768	0 703	**30.9**	11 611	4 870	**34.9**	11 460	9 185
27.0	0.0 011 762	070 481	**31.0**	0.0 011 607	064 720	**35.0**	0.0 011 456	059 033
27.1	11 759	0 370	**31.1**	11 603	4 570			
27.2	11 755	0 223	**31.2**	11 600	4 458			
27.3	11 751	070 075	**31.3**	11 596	4 308			
27.4	11 747	069 927	**31.4**	11 592	4 158			
27.5	11 743	9 779	**31.5**	11 588	4 009			
27.6	11 739	9 631	**31.6**	11 585	3 896			
27.7	11 735	9 483	**31.7**	11 581	3 746			
27.8	11 731	9 335	**31.8**	11 577	3 596			
27.9	11 727	9 187	**31.9**	11 573	3 446			

TABLE XVII

(Ostwald-Luther. Physiko-chemische Messungen)

Degrees C.	Apparent weight of a cc. of water	log	Volume of an apparent gram of water	log
10	.9 986	999 392	1.0 014	.000 608
11	85	9 348	15	0 651
12	84	9 305	16	0 694
13	83	9 261	17	0 738
14	82	9 218	18	0 781
15	81	9 174	19	0 824
16	79	9 087	21	0 911
17	77	9 000	23	0 998
18	76	8 956	24	1 041
19	74	8 869	26	1 128
20	72	8 782	28	1 214
21	70	8 695	30	1 301
22	67	8 565	33	1 431
23	65	8 477	35	1 517
24	63	8 390	37	1 604
25	60	8 259	40	1 734

SPECIFIC VOLUME OF WATER

(Thiesen, Scheel, and Diesselhorst, Wiss. Abh. d. Phys. Techn. Reichsanst. 3, 69)

Hydrogen Scale

	Tenth Degrees									
Degrees	0	1	2	3	4	5	6	7	8	9
0	1.000 132	126	119	113	107	101	095	089	084	079
1	073	069	064	059	055	051	047	043	039	035
2	032	029	026	023	020	018	016	013	011	009
3	008	006	005	004	003	002	001	001	000	000
4	000	000	000	001	001	002	003	004	005	007
5	008	010	012	014	016	018	021	023	026	029
6	032	035	039	042	046	050	054	058	062	066
7	071	075	080	085	090	096	101	107	112	118
8	124	130	137	143	149	156	163	170	177	184
9	192	199	207	215	223	231	239	247	256	264
10	273	282	291	300	309	319	328	338	348	358
11	368	378	388	399	409	420	431	442	453	464
12	476	487	499	511	522	534	547	559	571	584
13	596	609	622	635	648	661	675	688	702	715
14	729	743	757	772	786	800	815	830	844	859
15	874	890	905	920	936	951	967	983	999	*015
16	1.001 031	048	064	081	098	114	131	148	165	183
17	200	218	235	253	271	289	307	325	343	361
18	380	399	417	436	455	474	493	513	532	551
19	571	591	610	630	650	671	691	711	732	752
20	773	794	815	836	857	878	899	921	942	964
21	985	*007	*029	*051	*073	*096	*118	*140	*163	*186
22	1.002 208	231	254	277	300	324	347	370	394	418
23	441	465	489	513	538	562	586	611	635	660
24	685	710	735	760	785	810	835	861	886	912
25	938	964	990	*016	*042	*068	*094	*121	*147	*174
26	1.003 201	227	254	281	308	336	363	390	418	445
27	473	501	529	556	585	613	641	669	698	726
28	755	783	812	841	870	899	928	957	987	*016
29	1.004 046	075	105	135	165	194	225	255	285	315
30	346	376	407	437	468	499	530	561	592	623
31	655	686	717	749	781	812	844	876	908	940
32	972	*005	*037	*070	*102	*135	*167	*200	*233	*266
33	1.005 299	332	365	399	432	465	499	533	566	600
34	634	668	702	736	771	805	839	874	908	943
35	978	*013	*047	*082	*118	*153	*188	*223	*259	*294

DENSITY OF WATER

(Thiesen, Scheel, and Diesselhorst, Wiss. Abh. d. Phys. Techn. Reichsanst. 3, 68)

Hydrogen Scale

	Tenth Degrees									
Degrees	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
0	0.999 868	874	881	887	893	899	905	911	916	922
1	927	932	936	941	945	950	954	957	961	965
2	968	971	974	977	980	982	985	987	989	991
3	992	994	995	996	997	998	999	999	*000	*000
4	1.000 000	000	000	*999	*999	*998	*997	*996	*995	*993
5	0.999 992	990	988	986	984	982	979	977	974	971
6	968	965	962	958	954	951	947	943	938	934
7	929	925	920	915	910	904	899	893	888	882
8	876	870	864	857	851	844	837	830	823	816
9	808	801	793	785	778	769	761	753	744	736
10	727	718	709	700	691	681	672	662	652	642
11	632	622	612	601	591	580	569	558	547	536
12	525	513	502	490	478	466	454	442	429	417
13	404	391	379	366	353	339	326	312	299	285
14	271	257	243	229	215	200	186	171	156	141
15	126	111	096	081	065	050	034	018	002	*986
16	0.998 970	953	937	920	904	887	870	853	836	819
17	801	784	766	749	731	713	695	677	659	640
18	622	603	585	566	547	528	509	490	471	451
19	432	412	392	372	352	332	312	292	271	251
20	230	210	189	168	147	126	105	083	062	040
21	019	*997	*975	*953	*931	*909	*887	*864	*842	*819
22	0.997 797	774	751	728	705	682	659	635	612	588
23	565	541	517	493	469	445	421	396	372	347
24	323	298	273	248	223	198	173	147	122	096
25	071	045	019	*994	*968	*941	*915	*889	*863	*836
26	0.996 810	783	756	730	703	676	648	621	594	567
27	539	512	484	456	428	400	372	344	316	288
28	259	231	202	174	145	116	087	058	029	000
29	0.995 971	941	912	882	853	823	793	763	733	703
30	673	643	613	582	552	521	491	460	429	398
31	367	336	305	273	242	211	179	148	116	084
32	052	020	*988	*956	*924	*892	*859	*827	*794	*762
33	0.994 729	696	663	630	597	564	531	498	464	431
34	398	364	330	296	263	229	195	161	126	092
35	058	023	*989	*954	*920	*885	*850	*815	*780	*745

THE PROPORTION BY WEIGHT OF ABSOLUTE ALCOHOL IN 100 PARTS OF SPIRITS OF DIFFERENT SPECIFIC GRAVITIES (Fownes)						THE PROPORTION BY VOLUME OF ABSOLUTE ALCOHOL IN 100 VOLUMES OF SPIRITS OF DIFFERENT SPECIFIC GRAVITIES (Gay-Lussac)					
Sp. G. at 15.5°	**Per cent of real alcohol**	**Sp. G. at 15.5°**	**Per cent of real alcohol**	**Sp. G. at 15.5°**	**Per cent of real alcohol**	**Sp. G. at 15°**	**100 vol. spirits contain vol. of real alcohol**	**Sp. G. at 15°**	**100 vol. spirits contain vol. of real alcohol**	**Sp. G. at 15°**	**100 vol. spirits contain vol. of real alcohol**
.9991	0.5	.9511	34	.8769	68	.9985	1	.9594	35	.8932	69
.9981	1	.9490	35	.8745	69	.9970	2	.9581	36	.8907	70
.9965	2	.9470	36	.8721	70	.9956	3	.9567	37	.8882	71
.9947	3	.9452	37	.8696	71	.9942	4	.9553	38	.8857	72
.9930	4	.9434	38	.8672	72	.9929	5	.9538	39	.8831	73
.9914	5	.9416	39	.8649	73	.9916	6	.9523	40	.8805	74
.9898	6	.9396	40	.8625	74	.9903	7	.9507	41	.8779	75
.9884	7	.9376	41	.8603	75	.9891	8	.9491	42	.8753	76
.9869	8	.9356	42	.8581	76	.9878	9	.9474	43	.8726	77
.9855	9	.9335	43	.8557	77	.9867	10	.9457	44	.8699	78
.9841	10	.9314	44	.8833	78	.9855	11	.9440	45	.8672	79
.9828	11	.9292	45	.8508	79	.9844	12	.9422	46	.8645	80
.9815	12	.9270	46	.8483	80	.9833	13	.9404	47	.8617	81
.9802	13	.9249	47	.8459	81	.9822	14	.9386	48	.8589	82
.9789	14	.9228	48	.8434	82	.9812	15	.9367	49	.8560	83
.9778	15	.9206	49	.8408	83	.9802	16	.9348	50	.8531	84
.9766	16	.9184	50	.8382	84	.9792	17	.9329	51	.8502	85
.9753	17	.9160	51	.8357	85	.9782	18	.9309	52	.8472	86
.9741	18	.9135	52	.8331	86	.9773	19	.9289	53	.8442	87
.9728	19	.9113	53	.8305	87	.9763	20	.9269	54	.8411	88
.9716	20	.9090	54	.8279	88	.9753	21	.9248	55	.8379	89
.9704	21	.9069	55	.8254	89	.9742	22	.9227	56	.8346	90
.9691	22	.9047	56	.8228	90	.9732	23	.9206	57	.8312	91
.9678	23	.9025	57	.8199	91	.9721	24	.9185	58	.8278	92
.9665	24	.9001	58	.8172	92	.9711	25	.9163	59	.8242	93
.9652	25	.8979	59	.8145	93	.9700	26	.9141	60	.8206	94
.9638	26	.8956	60	.8118	94	.9690	27	.9119	61	.8168	95
.9623	27	.8932	61	.8089	95	.9679	28	.9096	62	.8128	96
.9609	28	.8908	62	.8061	96	.9668	29	.9073	63	.8086	97
.9593	29	.8886	63	.8031	97	.9657	30	.9050	64	.8042	98
.9578	30	.8863	64	.8001	98	.9645	31	.9027	65	.8006	99
.9560	31	.8840	65	.7969	99	.9633	32	.9004	66	.7947	100
.9544	32	.8816	66	.7938	100	.9621	33	.8980	67		
.9528	33	.8793	67			.9608	34	.8956	68		

TABLE XXI

SPECIFIC GRAVITY OF SOLUTIONS OF AMMONIUM HYDROXIDE AT 15° C.

(Lunge and Wiernik, Zeit. f. angew. Chem., 1889, 181)

Sp. G. at $\frac{15°}{4}$ in vacuo	Per cent NH_3 grams	1 liter contains NH_3 grams	Sp. G. at $\frac{15°}{4}$ in vacuo	Per cent NH_3 grams	1 liter contains NH_3 grams	Sp. G. at $\frac{15°}{4}$ in vacuo	Per cent NH_3 grams	1 liter contains NH_3 grams
1.000	.00	0.0	0.960	9.91	95.1	0.920	21.75	200.1
0.998	.45	4.5	958	10.47	100.3	918	22.39	205.6
996	.91	9.1	956	11.03	105.4	916	23.03	210.9
994	1.37	13.6	954	11.60	110.7	914	23.68	216.3
992	1.84	18.2	952	12.17	115.9	912	24.33	221.9
990	2.31	22.9	950	12.74	121.0	910	24.99	227.4
988	2.80	27.7	948	13.31	126.2	908	25.65	232.9
986	3.30	32.5	946	13.88	131.3	906	26.31	238.3
984	3.80	37.4	944	14.46	136.5	904	26.98	243.9
982	4.30	42.2	942	15.04	141.7	902	27.65	249.4
980	4.80	47.0	940	15.63	146.9	900	28.33	255.0
978	5.30	51.8	938	16.22	152.1	898	29.01	260.5
976	5.80	56.6	936	16.82	157.4	896	29.69	266.0
974	6.30	61.4	934	17.42	162.7	894	30.37	271.5
972	6.80	66.1	932	18.03	168.1	892	31.05	277.0
970	7.31	70.9	930	18.64	173.4	890	31.75	282.6
968	7.82	75.7	928	19.25	178.6	888	32.50	288.6
966	8.33	80.5	926	19.87	184.2	886	33.25	294.6
964	8.84	85.2	924	20.49	189.3	884	34.10	301.4
962	9.35	89.9	922	21.12	194.7	882	34.95	308.3

TABLE XXII

SPECIFIC GRAVITY OF SOLUTIONS OF HYDROCHLORIC ACID AT 15° C.

(Lunge and Marchlewski, Zeit. angew. Chem., 1891, 135)

Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams HCl	1 liter contains grams HCl	Sp. g. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams HCl	1 liter contains grams HCl	Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams HCl	1 liter contains grams HCl
1.000	0.16	1.6	1.070	14.17	152	1.140	27.66	315
1.005	1.15	12.0	1.075	15.16	163	1.145	28.61	328
1.010	2.14	22.0	1.080	16.15	174	1.150	29.57	340
1.015	3.12	32.0	1.085	17.13	186	1.155	30.55	353
1.020	4.13	42.0	1.090	18.11	197	1.160	31.52	366
1.025	5.15	53	1.095	19.06	209	1.165	32.49	379
1.030	6.15	64	1.100	20.01	220	1.170	33.46	392
1.035	7.15	74	1.105	20.97	232	1.175	34.42	404
1.040	8.16	85	1.110	21.92	243	1.180	35.39	418
1.045	9.16	96	1.115	22.86	255	1.185	36.31	430
1.050	10.17	107	1.120	23.82	267	1.190	37.23	443
1.055	11.18	118	1.125	24.78	278	1.195	38.16	456
1.060	12.19	129	1.130	25.75	291	1.200	39.11	469
1.065	13.19	141	1.135	26.70	303			

CONSTANT BOILING SOLUTION OF HYDROCHLORIC ACID

(Hulett and Bonner, Jour. Am. Chem. Soc., 31, 390)

Barometric pressure	Per cent HCl	Grams constant boiling distillate containing 1 mol HCl
770	20.218	180.390
760	20.242	180.170
750	20.266	179.960
740	20.290	179.745
730	20.314	179.530

The easiest and most accurate method of preparing standard solutions of hydrochloric acid is to weigh out a definite amount of the constant boiling solution of hydrochloric acid and dilute this to a certain volume. The constant boiling solution is obtained by diluting the concentrated hydrochloric acid of the laboratory with an equal volume of water. Distill from a retort or distilling flask connected with a condenser. When three fourths has been distilled off, change the receiver and collect as much of the remainder as is desirable. The last fraction is the constant boiling solution, and if the barometric pressure is noted, the exact weight of this solution which when diluted to a liter yields a normal solution can be ascertained by reference to the table.

SPECIFIC GRAVITY OF NITRIC ACID AT 15° C.

(Lunge and Rey, Zeit. angew. Chem., 1891, 165)

Specific gravity at 15° in vacuo	100 pts. by wt. contain grams HNO_3	1 liter contains grams HNO_3	Specific gravity at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams HNO_3	1 liter contains grams HNO_3	Specific gravity at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams HNO_3	1 liter contains grams HNO_3
1.000	0.10	1	1.205	33.09	399	1.410	67.50	952
1.005	1.00	10	1.210	33.82	409	1.415	68.63	971
1.010	1.90	19	1.215	34.55	420	1.420	69.80	991
1.015	2.80	28	1.220	35.28	430	1.425	70.98	1011
1.020	3.70	38	1.225	36.03	441	1.430	72.17	1032
1.025	4.60	47	1.230	36.78	452	1.435	73.39	1053
1.030	5.50	57	1.235	37.53	463	1.440	74.68	1075
1.035	6.38	66	1.240	38.29	475	1.445	75.98	1098
1.040	7.26	75	1.245	39.05	486	1.450	77.28	1121
1.045	8.13	85	1.250	39.82	498	1.455	78.60	1144
1.050	8.99	94	1.255	40.58	509	1.460	79.98	1168
1.055	9.84	104	1.260	41.34	521	1.465	81.42	1193
1.060	10.68	113	1.265	42.10	533	1.470	82.90	1219
1.065	11.51	123	1.270	42.87	544	1.475	84.45	1246
1.070	12.33	132	1.275	43.64	556	1.480	86.05	1274
1.075	13.15	141	1.280	44.41	568	1.485	87.70	1302
1.080	13.95	151	1.285	45.18	581	1.490	89.60	1335
1.085	14.74	160	1.290	45.95	593	1.495	91.60	1369
1.090	15.53	169	1.295	46.72	603	1.500	94.09	1411
1.095	16.32	179	1.300	47.49	617	1.501	94.60	1420
1.100	17.11	188	1.305	48.26	630	1.502	95.08	1428
1.105	17.89	198	1.310	49.07	643	1.503	95.55	1436
1.110	18.67	207	1.315	49.89	656	1.504	96.00	1444
1.115	19.45	217	1.320	50.71	669	1.505	96.39	1451
1.120	20.23	227	1.325	51.53	683	1.506	96.76	1457
1.125	21.00	236	1.330	52.37	697	1.507	97.13	1464
1.130	21.77	246	1.335	53.22	710	1.508	97.50	1470
1.135	22.54	256	1.340	54.07	725	1.509	97.84	1476
1.140	23.31	266	1.345	54.93	739	1.510	98.10	1481
1.145	24.08	276	1.350	55.79	753	1.511	98.32	1486
1.150	24.84	286	1.355	56.66	768	1.512	98.53	1490
1.155	25.60	296	1.360	57.57	783	1.513	98.73	1494
1.160	26.36	306	1.365	58.48	798	1.514	98.90	1497
1.165	27.12	316	1.370	59.39	814	1.515	99.01	1501
1.170	27.88	326	1.375	60.30	829	1.516	99.21	1504
1.175	28.63	336	1.380	61.27	846	1.517	99.34	1507
1.180	29.38	347	1.385	62.24	862	1.518	99.46	1510
1.185	30.13	357	1.390	63.23	879	1.519	99.57	1512
1.190	30.88	367	1.395	64.25	896	1.520	99.67	1515
1.195	31.62	378	1.400	65.30	914			
1.200	32.36	388	1.405	66.40	933			

SPECIFIC GRAVITY OF SULPHURIC ACID AT 15° C.

(Lunge, Isler and Naef, Zeit. angew. Chem., 1890, 131)

Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4	Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4	Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4
1.000	.09	1	1.225	30.48	373	1.450	55.03	798
1.005	.83	8	1.230	31.11	382	1.455	55.50	808
1.010	1.57	16	1.235	31.70	391	1.460	55.97	817
1.015	2.30	23	1.240	32.28	400	1.465	56.43	827
1.020	3.03	31	1.245	32.86	409	1.470	56.90	837
1.025	3.76	39	1.250	33.43	418	1.475	57.37	846
1.030	4.49	46	1.255	34.00	426	1.480	57.83	856
1.035	5.23	54	1.260	34.57	435	1.485	58.28	865
1.040	5.96	62	1.265	35.14	444	1.490	58.74	876
1.045	6.67	71	1.270	35.71	454	1.495	59.22	885
1.050	7.37	77	1.275	36.29	462	1.500	59.70	896
1.055	8.07	85	1.280	36.87	472	1.505	60.18	906
1.060	8.77	93	1.285	37.45	481	1.510	60.65	916
1.065	9.47	102	1.290	38.03	490	1.515	61.12	926
1.070	10.19	109	1.295	38.61	500	1.520	61.59	936
1.075	10.90	117	1.300	39.19	510	1.525	62.06	946
1.080	11.60	125	1.305	39.77	519	1.530	62.53	957
1.085	12.30	133	1.310	40.35	529	1.535	63.00	967
1.090	12.99	142	1.315	40.93	538	1.540	63.43	977
1.095	13.67	150	1.320	41.50	548	1.545	63.85	987
1.100	14.35	158	1.325	42.08	557	1.550	64.26	996
1.105	15.03	166	1.330	42.66	567	1.555	64.67	1006
1.110	15.71	175	1.335	43.20	577	1.560	65.08	1015
1.115	16.36	183	1.340	43.74	586	1.565	65.49	1025
1.120	17.01	191	1.345	44.28	596	1.570	65.90	1035
1.125	17.66	199	1.350	44.82	605	1.575	66.30	1044
1.130	18.31	207	1.355	45.35	614	1.580	66.71	1054
1.135	18.96	215	1.360	45.88	624	1.585	67.13	1064
1.140	19.61	223	1.365	46.41	633	1.590	67.59	1075
1.145	20.26	231	1.370	46.94	643	1.595	68.05	1085
1.150	20.91	239	1.375	47.47	653	1.600	68.51	1096
1.155	21.55	248	1.380	48.00	662	1.605	68.97	1107
1.160	22.19	257	1.385	48.53	672	1.610	69.43	1118
1.165	22.83	266	1.390	49.06	682	1.615	69.89	1128
1.170	23.47	275	1.395	49.59	692	1.620	70.32	1139
1.175	24.12	283	1.400	50.11	702	1.625	70.74	1150
1.180	24.76	292	1.405	50.63	711	1.630	71.16	1160
1.185	25.40	301	1.410	51.15	721	1.635	71.57	1170
1.190	26.04	310	1.415	51.66	730	1.640	71.99	1181
1.195	26.68	319	1.420	52.15	740	1.645	72.40	1192
1.200	27.32	328	1.425	52.63	750	1.650	72.82	1202
1.205	27.95	337	1.430	53.11	759	1.655	73.23	1212
1.210	28.58	346	1.435	53.59	769	1.660	73.64	1222
1.215	29.21	355	1.440	54.07	779	1.665	74.07	1233
1.220	29.84	364	1.445	54.55	789	1.670	74.51	1244

SPECIFIC GRAVITY OF SULFURIC ACID AT 15° C.

(Lunge, Isler and Naef, Zeit. angew. Chem., 1890, 131)

Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4	Sp. G at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4	Sp. G. at $\frac{15°}{4}$ in vacuo	100 pts. by wt. contain grams H_2SO_4	1 liter contains grams H_2SO_4
1.675	74.97	1256	1.775	83.90	1489	1.831	92.30	1690
1.680	75.42	1267	1.780	84.50	1504	1.832	92.52	1695
1.685	75.86	1278	1.785	85.10	1519	1.833	92.75	1700
1.690	76.30	1289	1.790	85.70	1534	1.834	93.05	1706
1.695	76.73	1301	1.795	86.30	1549	1.835	93.43	1713
1.700	77.17	1312	1.800	86.90	1564	1.836	93.80	1722
1.705	77.60	1323	1.805	87.60	1581	1.837	94.20	1730
1.710	78.04	1334	1.810	88.30	1598	1.838	94.60	1739
1.715	78.48	1346	1.815	89.05	1621	1.839	95.00	1748
1.720	78.92	1357	1.820	90.05	1639	1.840	95.60	1759
1.725	79.36	1369	1.821	90.20	1643	1.8405	95.95	1765
1.730	79.80	1381	1.822	90.40	1647	1.8410	97.00	1786
1.735	80.24	1392	1.823	90.60	1651	1.8415	97.70	1799
1.740	80.68	1404	1.824	90.80	1656	1.8410	98.20	1808
1.745	81.12	1416	1.825	91.00	1661	1.8405	98.70	1816
1.750	81.56	1427	1.826	91.25	1666	1.8400	99.20	1825
1.755	82.00	1439	1.827	91.50	1671	1.8395	99.45	1830
1.760	82.44	1451	1.828	91.70	1676	1.8390	99.70	1834
1.765	82.88	1463	1.829	91.90	1681	1.8385	99.95	1838
1.770	83.32	1475	1.830	92.10	1685			

CORRECTIONS FOR THE EXPOSED THREAD OF MERCURY THERMOMETERS

(Landolt-Börnstein)

$$n\beta(T-t)$$

n is the length of exposed thread expressed in terms of the thermometer graduations, β the apparent coefficient of expansion of mercury in glass, T the temperature read off, t, the mean temperature of the exposed thread. For temperatures lower than 100° β varies from $\frac{1}{6300}$ to $\frac{1}{6100}$, depending on the glass, and for higher temperatures the fraction is somewhat smaller.

$\frac{1}{10}$° THERMOMETERS, GRADUATED FROM 0° TO 100°

(Length of degrees about 4 mm.)

$T-t=$	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
$n=$ 10°	.05	.05	.05	.05	.05	.05	.05	.05	.1	.1	.1	.1
20°	.1	.1	.15	.15	.15	.15	.15	.20	.2	.2	.2	.25
30°	.2	.2	.25	.25	.25	.25	.25	.3	.3	.35	.35	.35
40°	.3	.3	.3	.35	.35	.35	.4	.4	.45	.45	.5	.5
50°	.35	.4	.4	.4	.45	.45	.5	.5	.55	.55	.6	.65
60°	.45	.5	.5	.55	.55	.55	.6	.65	.65	.7	.75	.8
70°						.65	.7	.7	.75	.8	.85	.9
80°							.75	.8	.85	.95	1.0	1.1
90°								.9	1.0	1.1	1.1	1.2
100°									1.1	1.2	1.3	1.3

TABLE XXVI *B*

THERMOMETERS GRADUATED FROM 0° TO 360°

(Length of degrees 1 to 1.6 mm.)

$T-t=$	70°	80°	90°	100°	110°	120°	130°	140°	150°	160°	170°	180°	190°	200°	210°	220°
$n=10°$	0.	.05	.05	.05	.1	.1	.1	.15	.2	.2	.2	.25	.3	.35	.35	.40
20°	.15	.15	.2	.2	.25	.3	.3	.4	.45	.45	.5	.55	.55	.60	.65	.65
30°	.25	.3	.35	.4	.45	.5	.55	.6	.65	.7	.75	.8	.85	.9	.95	.95
40°	.35	.4	.5	.55	.6	.7	.75	.8	.90	.95	1.0	1.0	1.1	1.2	1.2	1.3
50°	.45	.55	.6	.7	.8	.9	.95	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.6
60°	.55	.65	.75	.9	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9
70°	.7	.8	.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.9	2.0	2.1	2.2
80°	.8	.9	1.0	1.2	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
90°	.9	1.0	1.2	1.4	1.6	1.7	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.8	2.9
100°	1.0	1.2	1.3	1.6	1.8	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.1	3.2
110°				1.8	2.0	2.2	2.3	2.4	2.5	2.7	2.8	3.0	3.1	3.3	3.4	3.6
120°				2.0	2.2	2.4	2.6	2.7	2.8	2.9	3.1	3.3	3.4	3.6	3.7	3.9
130°					2.4	2.7	2.8	2.9	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3
140°					2.7	2.9	3.1	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.6
150°									3.5	3.7	4.0	4.1	4.3	4.6	4.8	5.0
160°									3.7	4.0	4.2	4.5	4.7	4.9	5.1	5.4
170°									4.0	4.3	4.5	4.8	5.0	5.2	5.5	5.8
180°									4.3	4.5	4.8	5.1	5.3	5.6	5.9	6.1
190°												5.4	5.6	5.9	6.2	6.5
200°												5.7	6.0	6.3	6.6	6.9
210°													6.3	6.7	7.0	7.3
220°													6.7	7.0	7.4	7.7

TABLE XXVII

FIXED POINTS OF THE THERMOMETRIC SCALE

(Transition temperatures)

	H. Scale	
$Na_2CrO_4 \cdot 10\,H_2O - Na_2CrO_4 \cdot 6\,H_2O$	19.525	
$Na_2CrO_4 \cdot 10\,H_2O - Na_2CrO_4 \cdot 4\,H_2O$	19.987	Richards and Kelley
$Na_2CrO_4 \cdot 6\,H_2O - Na_2CrO_4 \cdot 4\,H_2O$	25.90	
$Na_2CO_3 \cdot 10\,H_2O - Na_2CO_3 \cdot 7\,H_2O$	32.00	
$Na_2CO_3 \cdot 10\,H_2O - Na_2CO_3 \cdot H_2O$	32.96	Wells and McAdam
$Na_2CO_3 \cdot 7\,H_2O - Na_2CO_3 \cdot H_2O$	35.37	
$Na_2SO_4 \cdot 10\,H_2O - Na_2SO_4$	32.383	Richards and Wells
$NaBr \cdot 2\,H_2O - NaBr$	50.674	
$MnCl_2 \cdot 4\,H_2O - MnCl_2 \cdot 2\,H_2O$	58.089	Richards and Wrede

CORRECTIONS FOR LOSS OF WEIGHT IN AIR

The following table, calculated by Kohlrausch, contains corrections, C, expressed in milligrams, to be added algebraically to each gram of apparent weight of a substance, the specific gravity of which is S.

S	C	S	C	S	C
0.7	+ 1.57	2.0	+ 0.458	9	− 0.009
0.8	+ 1.36	2.5	+ 0.337	10	− 0.023
0.9	+ 1.19	3.0	+ 0.257	11	− 0.034
1.0	+ 1.06	3.5	+ 0.200	12	− 0.043
1.1	+ 0.95	4.0	+ 0.157	13	− 0.050
1.2	+ 0.86	4.5	+ 0.142	14	− 0.057
1.3	+ 0.78	5.0	+ 0.097	15	− 0.063
1.4	+ 0.71	5.5	+ 0.075	16	− 0.068
1.5	+ 0.66	6.0	+ 0.057	17	− 0.072
1.6	+ 0.61	6.5	+ 0.042	18	− 0.076
1.7	+ 0.56	7.0	+ 0.029	19	− 0.080
1.8	+ 0.52	7.5	+ 0.017	20	− 0.083
1.9	+ 0.49	8.0	+ 0.007		

The following values are of constant use in revising the atomic weights of the elements by means of their halides.

	Vacuum correction per apparent gram
Ag	− 0.000031 gram
AgBr	+ 0.000041 gram
AgCl	+ 0.000075 gram
AgI	+ 0.000071 gram

	Specific gravity	Vacuum correction per apparent gram
Brass weights	8.3	− 0.000145
Glass	2.5	+ 0.000335

LOGARITHMS OF NUMBERS

(From 1 to 10,000)

N.	log	N.	log	N.	log	N.	log
1	0.000000	26	1.414973	51	1.707570	76	1.880814
2	0.301030	27	1.431364	52	1.716003	77	1.886491
3	0.477121	28	1.447158	53	1.724276	78	1.892095
4	0.602060	29	1.462398	54	1.732394	79	1.897627
5	0.698970	30	1.477121	55	1.740363	80	1.903090
6	0.778151	31	1.491362	56	1.748188	81	1.908485
7	0.845098	32	1.505150	57	1.755875	82	1.913814
8	0.903090	33	1.518514	58	1.763428	83	1.919078
9	0.954243	34	1.531479	59	1.770852	84	1.924279
10	1.000000	35	1.544068	60	1.778151	85	1.929419
11	1.041393	36	1.556303	61	1.785330	86	1.934498
12	1.079181	37	1.568202	62	1.792392	87	1.939519
13	1.113943	38	1.579784	63	1.799341	88	1.944483
14	1.146128	39	1.591065	64	1.806181	89	1.949390
15	1.176091	40	1.602060	65	1.812913	90	1.954243
16	1.204120	41	1.612784	66	1.819544	91	1.959041
17	1.230449	42	1.623249	67	1.826075	92	1.963788
18	1.255273	43	1.633468	68	1.832509	93	1.968483
19	1.278754	44	1.643453	69	1.838849	94	1.973128
20	1.301030	45	1.653213	70	1.845098	95	1.977724
21	1.322219	46	1.662758	71	1.851258	96	1.982271
22	1.342423	47	1.672098	72	1.857333	97	1.986772
23	1.361728	48	1.681241	73	1.863323	98	1.991226
24	1.380211	49	1.690196	74	1.869232	99	1.995635
25	1.397940	50	1.698970	75	1.875061	100	2.000000

Remark. In the following table, in the nine right-hand columns of each page, where the first or leading figures change from 9's to 0's, asterisks are introduced instead of the 0's, to catch the eye, and to indicate that from thence the two figures of the logarithm to be taken from the second column stand in the next line below.

N.	0	1	2	3	4	5	6	7	8	9	D.
100	000000	0434	0868	1301	1734	2166	2598	3029	3461	3891	432
101	4321	4751	5181	5609	6038	6466	6894	7321	7748	8174	428
102	8600	9026	9451	9876	*300	*724	1147	1570	1993	2415	424
103	012837	3259	3680	4100	4521	4940	5360	5779	6197	6616	419
104	7033	7451	7868	8284	8700	9116	9532	9947	*361	*775	416
105	021189	1603	2016	2428	2841	3252	3664	4075	4486	4896	412
106	5306	5715	6125	6533	6942	7350	7757	8164	8571	8978	408
107	9384	9789	*195	*600	1004	1408	1812	2216	2619	3021	404
108	033424	3826	4227	4628	5029	5430	5830	6230	6629	7028	400
109	7426	7825	8223	8620	9017	9414	9811	*207	*602	*998	396
110	041393	1787	2182	2576	2969	3362	3755	4148	4540	4932	393
111	5323	5714	6105	6495	6885	7275	7664	8053	8442	8830	389
112	9218	9606	9993	*380	*766	1153	1538	1924	2309	2694	386
113	053078	3463	3846	4230	4613	4996	5378	5760	6142	6524	382
114	6905	7286	7666	8046	8426	8805	9185	9563	9942	*320	379
115	060698	1075	1452	1829	2206	2582	2958	3333	3709	4083	376
116	4458	4832	5206	5580	5953	6326	6699	7071	7443	7815	372
117	8186	8557	8928	9298	9668	**38	*407	*776	1145	1514	369
118	071882	2250	2617	2985	3352	3718	4085	4451	4816	5182	366
119	5547	5912	6276	6640	7004	7368	7731	8094	8457	8819	363
120	079181	9543	9904	*266	*626	*987	1347	1707	2067	2426	360
121	082785	3144	3503	3861	4219	4576	4934	5291	5647	6004	357
122	6360	6716	7071	7426	7781	8136	8490	8845	9198	9552	355
123	9905	*258	*611	*963	1315	1667	2018	2370	2721	3071	351
124	093422	3772	4122	4471	4820	5169	5518	5866	6215	6562	349
125	6910	7257	7604	7951	8298	8644	8990	9335	9681	**26	346
126	100371	0715	1059	1403	1747	2091	2434	2777	3119	3462	343
127	3804	4146	4487	4828	5169	5510	5851	6191	6531	6871	340
128	7210	7549	7888	8227	8565	8903	9241	9579	9916	*253	338
129	110590	0926	1263	1599	1934	2270	2605	2940	3275	3609	335
130	113943	4277	4611	4944	5278	5611	5943	6276	6608	6940	333
131	7271	7603	7934	8265	8595	8926	9256	9586	9915	*245	330
132	120574	0903	1231	1560	1888	2216	2544	2871	3198	3525	328
133	3852	4178	4504	4830	5156	5481	5806	6131	6456	6781	325
134	7105	7429	7753	8076	8399	8722	9045	9368	9690	**12	323
135	130334	0655	0977	1298	1619	1939	2260	2580	2900	3219	321
136	3539	3858	4177	4496	4814	5133	5451	5769	6086	6403	318
137	6721	7037	7354	7671	7987	8303	8618	8934	9249	9564	315
138	9879	*194	*508	*822	1136	1450	1763	2076	2389	2702	314
139	143015	3327	3639	3951	4263	4574	4885	5196	5507	5818	311
140	146128	6438	6748	7058	7367	7676	7985	8294	8603	8911	309
141	9219	9527	9835	*142	*449	*756	1063	1370	1676	1982	307
142	152288	2594	2900	3205	3510	3815	4120	4424	4728	5032	305
143	5336	5640	5943	6246	6549	6852	7154	7457	7759	8061	303
144	8362	8664	8965	9266	9567	9868	*168	*469	*769	1068	301
145	161368	1667	1967	2266	2564	2863	3161	3460	3758	4055	299
146	4353	4650	4947	5244	5541	5838	6134	6430	6726	7022	297
147	7317	7613	7908	8203	8497	8792	9086	9380	9674	9968	295
148	170262	0555	0848	1141	1434	1726	2019	2311	2603	2895	293
149	3186	3478	3769	4060	4351	4641	4932	5222	5512	5802	291
N.	0	1	2	3	4	5	6	7	8	9	D.

N.	0	1	2	3	4	5	6	7	8	9	D.
150	176091	6381	6670	6959	7248	7536	7825	8113	8401	8689	289
151	8977	9264	9552	9839	*126	*413	*699	*985	1272	1558	287
152	181844	2129	2415	2700	2985	3270	3555	3839	4123	4407	285
153	4691	4975	5259	5542	5825	6108	6391	6674	6956	7239	283
154	7521	7803	8084	8366	8647	8928	9209	9490	9771	**51	281
155	190332	0612	0892	1171	1451	1730	2010	2289	2567	2846	279
156	3125	3403	3681	3959	4237	4514	4792	5069	5346	5623	278
157	5899	6176	6453	6729	7005	7281	7556	7832	8107	8382	276
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159	201397	1670	1943	2216	2488	2761	3033	3305	3577	3848	272
160	204120	4391	4663	4934	5204	5475	5746	6016	6286	6556	271
161	6826	7096	7365	7634	7904	8173	8441	8710	8979	9247	269
162	9515	9783	**51	*319	*586	*853	1121	1388	1654	1921	267
163	212188	2454	2720	2986	3252	3518	3783	4049	4314	4579	266
164	4844	5109	5373	5638	5902	6166	6430	6694	6957	7221	264
165	7484	7747	8010	8273	8536	8798	9060	9323	9585	9846	262
166	220108	0370	0631	0892	1153	1414	1675	1936	2196	2456	261
167	2716	2976	3236	3496	3755	4015	4274	4533	4792	5051	259
168	5309	5568	5826	6084	6342	6600	6858	7115	7372	7630	258
169	7887	8144	8400	8657	8913	9170	9426	9682	9938	*193	256
170	230449	0704	0960	1215	1470	1724	1979	2234	2488	2742	254
171	2996	3250	3504	3757	4011	4264	4517	4770	5023	5276	253
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175	3038	3286	3534	3782	4030	4277	4525	4772	5019	5266	248
176	5513	5759	6006	6252	6499	6745	6991	7237	7482	7728	246
177	7973	8219	8464	8709	8954	9198	9443	9687	9932	*176	245
178	250420	0664	0908	1151	1395	1638	1881	2125	2368	2610	243
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182	260071	0310	0548	0787	1025	1263	1501	1739	1976	2214	238
183	2451	2688	2925	3162	3399	3636	3873	4109	4346	4582	237
184	4818	5054	5290	5525	5761	5996	6232	6467	6702	6937	235
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186	9513	9746	9980	*213	*446	*679	*912	1144	1377	1609	233
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191	281033	1261	1488	1715	1942	2169	2396	2622	2849	3075	227
192	3301	3527	3753	3979	4205	4431	4656	4882	5107	5332	226
193	5557	5782	6007	6232	6456	6681	6905	7130	7354	7578	225
194	7802	8026	8249	8473	8696	8920	9143	9366	9589	9812	223
195	290035	0257	0480	0702	0925	1147	1369	1591	1813	2034	222
196	2256	2478	2699	2920	3141	3363	3584	3804	4025	4246	221
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209	320146	0354	0562	0769	0977	1184	1391	1598	1805	2012	207
210	322219	2426	2633	2839	3046	3252	3458	3665	3871	4077	206
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221	4392	4589	4785	4981	5178	5374	5570	5766	5962	6157	196
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226	4108	4301	4493	4685	4876	5068	5260	5452	5643	5834	192
227	6026	6217	6408	6599	6790	6981	7172	7363	7554	7744	191
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229	9835	**25	*215	*404	*593	*783	*972	1161	1350	1539	189
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233	7356	7542	7729	7915	8101	8287	8473	8659	8845	9030	186
234	9216	9401	9587	9772	9958	*143	*328	*513	*698	*883	185
235	371068	1253	1437	1622	1806	1991	2175	2360	2544	2728	184
236	2912	3096	3280	3464	3647	3831	4015	4198	4382	4565	184
237	4748	4932	5115	5298	5481	5664	5846	6029	6212	6394	183
238	6577	6759	6942	7124	7306	7488	7670	7852	8034	8216	182
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241	2017	2197	2377	2557	2737	2917	3097	3277	3456	3636	180
242	3815	3995	4174	4353	4533	4712	4891	5070	5249	5428	179
243	5606	5785	5964	6142	6321	6499	6677	6856	7034	7212	178
244	7390	7568	7746	7923	8101	8279	8456	8634	8811	8989	178
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257	9933	*102	*271	*440	*609	*777	*946	1114	1283	1451	169
258	411620	1788	1956	2124	2293	2461	2629	2796	2964	3132	168
259	3300	3467	3635	3803	3970	4137	4305	4472	4639	4806	167
260	414973	5140	5307	5474	5641	5808	5974	6141	6308	6474	167
261	6641	6807	6973	7139	7306	7472	7638	7804	7970	8135	166
262	8301	8467	8633	8798	8964	9129	9295	9460	9625	9791	165
263	9956	*121	*286	*451	*616	*781	*945	1110	1275	1439	165
264	421604	1788	1933	2097	2261	2426	2590	2754	2918	3082	164
265	3246	3410	3574	3737	3901	4065	4228	4392	4555	4718	164
266	4882	5045	5208	5371	5534	5697	5860	6023	6186	6349	163
267	6511	6674	6836	6999	7161	7324	7486	7648	7811	7973	162
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269	9752	9914	**75	*236	*398	*559	*720	*881	1042	1203	161
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272	4569	4729	4888	5048	5207	5367	5526	5685	5844	6004	159
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274	7751	7909	8067	8226	8384	8542	8701	8859	9017	9175	158
275	9333	9491	9648	9806	9964	*122	*279	*437	*594	*752	158
276	440909	1066	1224	1381	1538	1695	1852	2009	2166	2323	157
277	2480	2637	2793	2950	3106	3263	3419	3576	3732	3889	157
278	4045	4201	4357	4513	4669	4825	4981	5137	5293	5449	156
279	5604	5760	5915	6071	6226	6382	6537	6692	6848	7003	155
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295	9822	9969	*116	*263	*410	*557	*704	*851	*998	1145	147
296	471292	1438	1585	1732	1878	2025	2171	2318	2464	2610	146
297	2756	2903	3049	3195	3341	3487	3633	3779	3925	4071	146
298	4216	4362	4508	4653	4799	4944	5090	5235	5381	5526	146
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303	1443	1586	1729	1872	2016	2159	2302	2445	2588	2731	143
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307	7138	7280	7421	7563	7704	7845	7986	8127	8269	8410	141
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345	7819	7945	8071	8197	8322	8448	8574	8699	8825	8951	126
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361	7507	7627	7748	7868	7988	8108	8228	8349	8469	8589	120
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367	4666	4784	4903	5021	5139	5257	5376	5494	5612	5730	118
368	5848	5966	6084	6202	6320	6437	6555	6673	6791	6909	118
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371	9374	9491	9608	9725	9842	9959	**76	*193	*309	*426	117
372	570543	0660	0776	0893	1010	1126	1243	1359	1476	1592	117
373	1709	1825	1942	2058	2174	2291	2407	2523	2639	2755	116
374	2872	2988	3104	3220	3336	3452	3568	3684	3800	3915	116
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383	3199	3312	3426	3539	3652	3765	3879	3992	4105	4218	113
384	4331	4444	4557	4670	4783	4896	5009	5122	5235	5348	113
385	5461	5574	5686	5799	5912	6024	6137	6250	6362	6475	113
386	6587	6700	6812	6925	7037	7149	7262	7374	7486	7599	112
387	7711	7823	7935	8047	8160	8272	8384	8496	8608	8720	112
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389	9950	**61	*173	*284	*396	*507	*619	*730	*842	*953	112
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393	4393	4503	4614	4724	4834	4945	5055	5165	5276	5386	110
394	5496	5606	5717	5827	5937	6047	6157	6267	6377	6487	110
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398	9883	9992	*101	*210	*319	*428	*537	*646	*755	*864	109
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403	5305	5413	5521	5628	5736	5844	5951	6059	6166	6274	108
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405	7455	7562	7669	7777	7884	7991	8098	8205	8312	8419	107
406	8526	8633	8740	8847	8954	9061	9167	9274	9381	9488	107
407	9594	9701	9808	9914	**21	*128	*234	*341	*447	*554	107
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409	1723	1829	1936	2042	2148	2254	2360	2466	2572	2678	106
410	612784	2890	2996	3102	3207	3313	3419	3525	3630	3736	106
411	3842	3947	4053	4159	4264	4370	4475	4581	4686	4792	106
412	4897	5003	5108	5213	5319	5424	5529	5634	5740	5845	105
413	5950	6055	6160	6265	6370	6476	6581	6686	6790	6895	105
414	7000	7105	7210	7315	7420	7525	7629	7734	7839	7943	105
415	8048	8153	8257	8362	8466	8571	8676	8780	8884	8989	105
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427	630428	0530	0631	0733	0835	0936	1038	1139	1241	1342	102
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441	4439	4537	4636	4734	4832	4931	5029	5127	5226	5324	98
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443	6404	6502	6600	6698	6796	6894	6992	7089	7187	7285	98
444	7383	7481	7579	7676	7774	7872	7969	8067	8165	8262	98
445	8360	8458	8555	8653	8750	8848	8945	9043	9140	9237	97
446	9335	9432	9530	9627	9724	9821	9919	**16	*113	*210	97
447	650308	0405	0502	0599	0696	0793	0890	0987	1084	1181	97
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452	5138	5235	5331	5427	5523	5619	5715	5810	5906	6002	96
453	6098	6194	6290	6386	6482	6577	6673	6769	6864	6960	96
454	7056	7152	7247	7343	7438	7534	7629	7725	7820	7916	96
455	8011	8107	8202	8298	8393	8488	8584	8679	8774	8870	95
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460	662758	2852	2947	3041	3135	3230	3324	3418	3512	3607	94
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462	4642	4736	4830	4924	5018	5112	5206	5299	5393	5487	94
463	5581	5675	5769	5862	5956	6050	6143	6237	6331	6424	94
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465	7453	7546	7640	7733	7826	7920	8013	8106	8199	8293	93
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467	9317	9410	9503	9596	9689	9782	9875	9967	**60	*153	93
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469	1173	1265	1358	1451	1543	1636	1728	1821	1913	2005	93
470	672098	2190	2283	2375	2467	2560	2652	2744	2836	2929	92
471	3021	3113	3205	3297	3390	3482	3574	3666	3758	3850	92
472	3942	4034	4126	4218	4310	4402	4494	4586	4677	4769	92
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474	5778	5870	5962	6053	6145	6236	6328	6419	6511	6602	92
475	6694	6785	6876	6968	7059	7151	7242	7333	7424	7516	91
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494	3727	3815	3903	3991	4078	4166	4254	4342	4430	4517	88
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508	5864	5949	6035	6120	6206	6291	6376	6462	6547	6632	85
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540	732394	2474	2555	2635	2715	2796	2876	2956	3037	3117	80
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543	4800	4880	4960	5040	5120	5200	5279	5359	5439	5519	80
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545	6397	6476	6556	6635	6715	6795	6874	6954	7034	7113	80
546	7193	7272	7352	7431	7511	7590	7670	7749	7829	7908	79
547	7987	8067	8146	8225	8305	8384	8463	8543	8622	8701	79
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553	2725	2804	2882	2961	3039	3118	3196	3275	3353	3431	78
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555	4293	4371	4449	4528	4606	4684	4762	4840	4919	4997	78
556	5075	5153	5231	5309	5387	5465	5543	5621	5699	5777	78
557	5855	5933	6011	6089	6167	6245	6323	6401	6479	6556	78
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560	748188	8266	8343	8421	8498	8576	8653	8731	8808	8885	77
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565	2048	2125	2202	2279	2356	2433	2509	2586	2663	2740	77
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568	4348	4425	4501	4578	4654	4730	4807	4883	4960	5036	76
569	5112	5189	5265	5341	5417	5494	5570	5646	5722	5799	76
570	755875	5951	6027	6103	6180	6256	6332	6408	6484	6560	76
571	6636	6712	6788	6864	6940	7016	7092	7168	7244	7320	76
572	7396	7472	7548	7624	7700	7775	7851	7927	8003	8079	76
573	8155	8230	8306	8382	8458	8533	8609	8685	8761	8836	76
574	8912	8988	9063	9139	9214	9290	9366	9441	9517	9592	76
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578	1928	2003	2078	2153	2228	2303	2378	2453	2529	2604	75
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584	6413	6487	6562	6636	6710	6785	6859	6933	7007	7082	74
585	7156	7230	7304	7379	7453	7527	7601	7675	7749	7823	74
586	7898	7972	8046	8120	8194	8268	8342	8416	8490	8564	74
587	8638	8712	8786	8860	8934	9008	9082	9156	9230	9303	74
588	9377	9451	9525	9599	9673	9746	9820	9894	9968	**42	74
589	770115	0189	0263	0336	0410	0484	0557	0631	0705	0778	74
590	770852	0926	0999	1073	1146	1220	1293	1367	1440	1514	74
591	1587	1661	1734	1808	1881	1955	2028	2102	2175	2248	73
592	2322	2395	2468	2542	2615	2688	2762	2835	2908	2981	73
593	3055	3128	3201	3274	3348	3421	3494	3567	3640	3713	73
594	3786	3860	3933	4006	4079	4152	4225	4298	4371	4444	73
595	4517	4590	4663	4736	4809	4882	4955	5028	5100	5173	73
596	5246	5319	5392	5465	5538	5610	5683	5756	5829	5902	73
597	5974	6047	6120	6193	6265	6338	6411	6483	6556	6629	73
598	6701	6774	6846	6919	6992	7064	7137	7209	7282	7354	73
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602	9596	9669	9741	9813	9885	9957	**29	*101	*173	*245	72
603	780317	0389	0461	0533	0605	0677	0749	0821	0893	0965	72
604	1037	1109	1181	1253	1324	1396	1468	1540	1612	1684	72
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606	2473	2544	2616	2688	2759	2831	2902	2974	3046	3117	72
607	3189	3260	3332	3403	3475	3546	3618	3689	3761	3832	71
608	3904	3975	4046	4118	4189	4261	4332	4403	4475	4546	71
609	4617	4689	4760	4831	4902	4974	5045	5116	5187	5259	71
610	785330	5401	5472	5543	5615	5686	5757	5828	5899	5970	71
611	6041	6112	6183	6254	6325	6396	6467	6538	6609	6680	71
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613	7460	7531	7602	7673	7744	7815	7885	7956	8027	8098	71
614	8168	8239	8310	8381	8451	8522	8593	8663	8734	8804	71
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645	9560	9627	9694	9762	9829	9896	9964	**31	**98	*165	67
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665	2822	2887	2952	3018	3083	3148	3213	3279	3344	3409	65
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667	4126	4191	4256	4321	4386	4451	4516	4581	4646	4711	65
668	4776	4841	4906	4971	5036	5101	5166	5231	5296	5361	65
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671	6723	6787	6852	6917	6981	7046	7111	7175	7240	7305	65
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673	8015	8080	8144	8209	8273	8338	8402	8467	8531	8595	64
674	8660	8724	8789	8853	8918	8982	9046	9111	9175	9239	64
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676	9947	**11	**75	*139	*204	*268	*332	*396	*460	*525	64
677	830589	0653	0717	0781	0845	0909	0973	1037	1102	1166	64
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704	7573	7634	7696	7758	7819	7881	7943	8004	8066	8128	62
705	8189	8251	8312	8374	8435	8497	8559	8620	8682	8743	62
706	8805	8866	8928	8989	9051	9112	9174	9235	9297	9358	61
707	9419	9481	9542	9604	9665	9726	9788	9849	9911	9972	61
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727	1534	1594	1654	1714	1773	1833	1893	1952	2012	2072	60
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745	2156	2215	2273	2331	2389	2448	2506	2564	2622	2681	58
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748	3902	3960	4018	4076	4134	4192	4250	4308	4366	4424	58
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776	9862	9918	9974	**30	**86	*141	*197	*253	*309	*365	56
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779	1537	1593	1649	1705	1760	1816	1872	1928	1983	2039	56
780	892095	2150	2206	2262	2317	2373	2429	2484	2540	2595	56
781	2651	2707	2762	2818	2873	2929	2985	3040	3096	3151	56
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789	7077	7132	7187	7242	7297	7352	7407	7462	7517	7572	55
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798	2003	2057	2112	2166	2221	2275	2329	2384	2438	2492	54
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804	5256	5310	5364	5418	5472	5526	5580	5634	5688	5742	54
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807	6874	6927	6981	7035	7089	7143	7196	7250	7304	7358	54
808	7411	7465	7519	7573	7626	7680	7734	7787	7841	7895	54
809	7949	8002	8056	8110	8163	8217	8270	8324	8378	8431	54
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827	7506	7558	7611	7663	7716	7768	7820	7873	7925	7978	52
828	8030	8083	8135	8188	8240	8293	8345	8397	8450	8502	52
829	8555	8607	8659	8712	8764	8816	8869	8921	8973	9026	52
830	919078	9130	9183	9235	9287	9340	9392	9444	9496	9549	52
831	9601	9653	9706	9758	9810	9862	9914	9967	**19	**71	52
832	920123	0176	0228	0280	0332	0384	0436	0489	0541	0593	52
833	0645	0697	0749	0801	0853	0906	0958	1010	1062	1114	52
834	1166	1218	1270	1322	1374	1426	1478	1530	1582	1634	52
835	1686	1738	1790	1842	1894	1946	1998	2050	2102	2154	52
836	2206	2258	2310	2362	2414	2466	2518	2570	2622	2674	52
837	2725	2777	2829	2881	2933	2985	3037	3089	3140	3192	52
838	3244	3296	3348	3399	3451	3503	3555	3607	3658	3710	52
839	3762	3814	3865	3917	3969	4021	4072	4124	4176	4228	52
840	924279	4331	4383	4434	4486	4538	4589	4641	4693	4744	52
841	4796	4848	4899	4951	5003	5054	5106	5157	5209	5261	52
842	5312	5364	5415	5467	5518	5570	5621	5673	5725	5776	52
843	5828	5879	5931	5982	6034	6085	6137	6188	6240	6291	51
844	6342	6394	6445	6497	6548	6600	6651	6702	6754	6805	51
845	6857	6908	6959	7011	7062	7114	7165	7216	7268	7319	51
846	7370	7422	7473	7524	7576	7627	7678	7730	7781	7832	51
847	7883	7935	7986	8037	8088	8140	9191	8242	8293	8345	51
848	8396	8447	8498	8549	8601	8652	8703	8754	8805	8857	51
849	8908	8959	9010	9061	9112	9163	9215	9266	9317	9368	51
N.	0	1	2	3	4	5	6	7	8	9	D.

N.	0	1	2	3	4	5	6	7	8	9	D.
850	929419	9470	9521	9572	9623	9674	9725	9776	9827	9879	51
851	9930	9981	**32	**83	*134	*185	*236	*287	*338	*389	51
852	930440	0491	0542	0592	0643	0694	0745	0796	0847	0898	51
853	0949	1000	1051	1102	1153	1204	1254	1305	1356	1407	51
854	1458	1509	1560	1610	1661	1712	1763	1814	1865	1915	51
855	1966	2017	2068	2118	2169	2220	2271	2322	2372	2423	51
856	2474	2524	2575	2626	2677	2727	2778	2829	2879	2930	51
857	2981	3031	3082	3133	3183	3234	3285	3335	3386	3437	51
858	3487	3538	3589	3639	3690	3740	3791	3841	3892	3943	51
859	3993	4044	4094	4145	4195	4246	4296	4347	4397	4448	51
860	934498	4549	4599	4650	4700	4751	4801	4852	4902	4953	50
861	5003	5054	5104	5154	5205	5255	5306	5356	5406	5457	50
862	5507	5558	5608	5658	5709	5759	5809	5860	5910	5960	50
863	6011	6061	6111	6162	6212	6262	6313	6363	6413	6463	50
864	6514	6564	6614	6665	6715	6765	6815	6865	6916	6966	50
865	7016	7066	7117	7167	7217	7267	7317	7367	7418	7468	50
866	7518	7568	7618	7668	7718	7769	7819	7869	7919	7969	50
867	8019	8069	8119	8169	8219	8269	8320	8370	8420	8470	50
868	8520	8570	8620	8670	8720	8770	8820	8870	8920	8970	50
869	9020	9070	9120	9170	9220	9270	9320	9369	9419	9469	50
870	939519	9569	9619	9669	9719	9769	9819	9869	9918	9968	50
871	940018	0068	0118	0168	0218	0267	0317	0367	0417	0467	50
872	0516	0566	0616	0666	0716	0765	0815	0865	0915	0964	50
873	1014	1064	1114	1163	1213	1263	1313	1362	1412	1462	50
874	1511	1561	1611	1660	1710	1760	1809	1859	1909	1958	50
875	2008	2058	2107	2157	2207	2256	2306	2355	2405	2455	50
876	2504	2554	2603	2653	2702	2752	2801	2851	2901	2950	50
877	3000	3049	3099	3148	3198	3247	3297	3346	3396	3445	49
878	3495	3544	3593	3643	3692	3742	3791	3841	3890	3939	49
879	3989	4038	4088	4137	4186	4236	4285	4335	4384	4433	49
880	944483	4532	4581	4631	4680	4729	4779	4828	4877	4927	49
881	4976	5025	5074	5124	5173	5222	5272	5321	5370	5419	49
882	5469	5518	5567	5616	5665	5715	5764	5813	5862	5912	49
883	5961	6010	6059	6108	6157	6207	6256	6305	6354	6403	49
884	6452	6501	6551	6600	6649	6698	6747	6796	6845	6894	49
885	6943	6992	7041	7090	7140	7189	7238	7287	7336	7385	49
886	7434	7483	7532	7581	7630	7679	7728	7777	7826	7875	49
887	7924	7973	8022	8070	8119	8168	8217	8266	8315	8364	49
888	8413	8462	8511	8560	8609	8657	8706	8755	8804	8853	49
889	8902	8951	8999	9048	9097	9146	9195	9244	9292	9341	49
890	949390	9439	9488	9536	9585	9634	9683	9731	9780	9829	49
891	9878	9926	9975	**24	**73	*121	*170	*219	*267	*316	49
892	950365	0414	0462	0511	0560	0608	0657	0706	0754	0803	49
893	0851	0900	0949	0997	1046	1095	1143	1192	1240	1289	49
894	1338	1386	1435	1483	1532	1580	1629	1677	1726	1775	49
895	1823	1872	1920	1969	2017	2066	2114	2163	2211	2260	48
896	2308	2356	2405	2453	2502	2550	2599	2647	2696	2744	48
897	2792	2841	2889	2938	2986	3034	3083	3131	3180	3228	48
898	3276	3325	3373	3421	3470	3518	3566	3615	3663	3711	48
899	3760	3808	3856	3905	3953	4001	4049	4098	4146	4194	48
N.	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**D.**

N.	0	1	2	3	4	5	6	7	8	9	D.
900	954243	4291	4339	4387	4435	4484	4532	4580	4628	4677	48
901	4725	4773	4821	4869	4918	4966	5014	5062	5110	5158	48
902	5207	5255	5303	5351	5399	5447	5495	5543	5592	5640	48
903	5688	5736	5784	5832	5880	5928	5976	6024	6072	6120	48
904	6168	6216	6265	6313	6361	6409	6457	6505	6553	6601	48
905	6649	6697	6745	6793	6840	6888	6936	6984	7032	7080	48
906	7128	7176	7224	7272	7320	7368	7416	7464	7512	7559	48
907	7607	7655	7703	7751	7799	7847	7894	7942	7990	8038	48
908	8086	8134	8181	8229	8277	8325	8373	8421	8468	8516	48
909	8564	8612	8659	8707	8755	8803	8850	8898	8946	8994	48
910	959041	9089	9137	9185	9232	9280	9328	9375	9423	9471	48
911	9518	9566	9614	9661	9709	9757	9804	9852	9900	9947	48
912	9995	**42	**90	*138	*185	*233	*280	*328	*376	*423	48
913	960471	0518	0566	0613	0661	0709	0756	0804	0851	0899	48
914	0946	0994	1041	1089	1136	1184	1231	1279	1326	1374	47
915	1421	1469	1516	1563	1611	1658	1706	1753	1801	1848	47
916	1895	1943	1990	2038	2085	2132	2180	2227	2275	2322	47
917	2369	2417	2464	2511	2559	2606	2653	2701	2748	2795	47
918	2843	2890	2937	2985	3032	3079	3126	3174	3221	3268	47
919	3316	3363	3410	3457	3504	3552	3599	3646	3693	3741	47
920	963788	3835	3882	3929	3977	4024	4071	4118	4165	4212	47
921	4260	4307	4354	4401	4448	4495	4542	4590	4637	4684	47
922	4731	4778	4825	4872	4919	4966	5013	5061	5108	5155	47
923	5202	5249	5296	5343	5390	5437	5484	5531	5578	5625	47
924	5672	5719	5766	5813	5860	5907	5954	6001	6048	6095	47
925	6142	6189	6236	6283	6329	6376	6423	6470	6517	6564	47
926	6611	6658	6705	6752	6799	6845	6892	6939	6986	7033	47
927	7080	7127	7173	7220	7267	7314	7361	7408	7454	7501	47
928	7548	7595	7642	7688	7735	7782	7829	7875	7922	7969	47
929	8016	8062	8109	8156	8203	8249	8296	8343	8390	8436	47
930	968483	8530	8576	8623	8670	8716	8763	8810	8856	8903	47
931	8950	8996	9043	9090	9136	9183	9229	9276	9323	9369	47
932	9416	9463	9509	9556	9602	9649	9695	9742	9789	9835	47
933	9882	9928	9975	**21	**68	*114	*161	*207	*254	*300	47
934	970347	0393	0440	0486	0533	0579	0626	0672	0719	0765	46
935	0812	0858	0904	0951	0997	1044	1090	1137	1183	1229	46
936	1276	1322	1369	1415	1461	1508	1554	1601	1647	1693	46
937	1740	1786	1832	1879	1925	1971	2018	2064	2110	2157	46
938	2203	2249	2295	2342	2388	2434	2481	2527	2573	2619	46
939	2666	2712	2758	2804	2851	2897	2943	2989	3035	3082	46
940	973128	3174	3220	3266	3313	3359	3405	3451	3497	3543	46
941	3590	3636	3682	3728	3774	3820	3866	3913	3959	4005	46
942	4051	4097	4143	4189	4235	4281	4327	4374	4420	4466	46
943	4512	4558	4604	4650	4696	4742	4788	4834	4880	4926	46
944	4972	5018	5064	5110	5156	5202	5248	5294	5340	5386	46
945	5432	5478	5524	5570	5616	5662	5707	5753	5799	5845	46
946	5891	5937	5983	6029	6075	6121	6167	6212	6258	6304	46
947	6350	6396	6442	6488	6533	6579	6625	6671	6717	6763	46
948	6808	6854	6900	6946	6992	7037	7083	7129	7175	7220	46
949	7266	7312	7358	7403	7449	7495	7541	7586	7632	7678	46
N.	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**D.**

N.	0	1	2	3	4	5	6	7	8	9	D.
950	977724	7769	7815	7861	7906	7952	7998	8043	8089	8135	46
951	8181	8226	8272	8317	8363	8409	8454	8500	8546	8591	46
952	8637	8683	8728	8774	8819	8865	8911	8956	9002	9047	46
953	9093	9138	9184	9230	9275	9321	9366	9412	9457	9503	46
954	9548	9594	9639	9685	9730	9776	9821	9867	9912	9958	46
955	980003	0049	0094	0140	0185	0231	0276	0322	0367	0412	45
956	0458	0503	0549	0594	0640	0685	0730	0776	0821	0867	45
957	0912	0957	1003	1048	1093	1139	1184	1229	1275	1320	45
958	1365	1411	1456	1501	1547	1592	1637	1683	1728	1773	45
959	1819	1864	1909	1954	2000	2045	2090	2135	2181	2226	45
960	982271	2316	2362	2407	2452	2497	2543	2588	2633	2678	45
961	2723	2769	2814	2859	2904	2949	2994	3040	3085	3130	45
962	3175	3220	3265	3310	3356	3401	3446	3491	3536	3581	45
963	3626	3671	3716	3762	3807	3852	3897	3942	3987	4032	45
964	4077	4122	4167	4212	4257	4302	4347	4392	4437	4482	45
965	4527	4572	4617	4662	4707	4752	4797	4842	4887	4932	45
966	4977	5022	5067	5112	5157	5202	5247	5292	5337	5382	45
967	5426	5471	5516	5561	5606	5651	5696	5741	5786	5830	45
968	5875	5920	5965	6010	6055	6100	6144	6189	6234	6279	45
969	6324	6369	6413	6458	6503	6548	6593	6637	6682	6727	45
970	986772	6817	6861	6906	6951	6996	7040	7085	7130	7175	45
971	7219	7264	7309	7353	7398	7443	7488	7532	7577	7622	45
972	7666	7711	7756	7800	7845	7890	7934	7979	8024	8068	45
973	8113	8157	8202	8247	8291	8336	8381	8425	8470	8514	45
974	8559	8604	8648	8693	8737	8782	8826	8871	8916	8960	45
975	9005	9049	9094	9138	9183	9227	9272	9316	9361	9405	45
976	9450	9494	9539	9583	9628	9672	9717	9761	9806	9850	44
977	9895	9939	9983	**28	**72	*117	*161	*206	*250	*294	44
978	990339	0383	0428	0472	0516	0561	0605	0650	0694	0738	44
979	0783	0827	0871	0916	0960	1004	1049	1093	1137	1182	44
980	991226	1270	1315	1359	1403	1448	1492	1536	1580	1625	44
981	1669	1713	1758	1802	1846	1890	1935	1979	2023	2067	44
982	2111	2156	2200	2244	2288	2333	2377	2421	2465	2509	44
983	2554	2598	2642	2686	2730	2774	2819	2863	2907	2951	44
984	2995	3039	3083	3127	3172	3216	3260	3304	3348	3392	44
985	3436	3480	3524	3568	3613	3657	3701	3745	3789	3833	44
986	3877	3921	3965	4009	4053	4097	4141	4185	4229	4273	44
987	4317	4361	4405	4449	4493	4537	4581	4625	4669	4713	44
988	4757	4801	4845	4889	4933	4977	5021	5065	5108	5152	44
989	5196	5240	5284	5328	5372	5416	5460	5504	5547	5591	44
990	995635	5679	5723	5767	5811	5854	5898	5942	5986	6030	44
991	6074	6117	6161	6205	6249	6293	6337	6380	6424	6468	44
992	6512	6555	6599	6643	6687	6731	6774	6818	6862	6906	44
993	6949	6993	7037	7080	7124	7168	7212	7255	7299	7343	44
994	7386	7430	7474	7517	7561	7605	7648	7692	7736	7779	44
995	7823	7867	7910	7954	7998	8041	8085	8129	8172	8216	44
996	8259	8303	8347	8390	8434	8477	8521	8564	8608	8652	44
997	8695	8739	8782	8826	8869	8913	8956	9000	9043	9087	44
998	9131	9174	9218	9261	9305	9348	9392	9435	9479	9522	44
999	9565	9609	9652	9696	9739	9783	9826	9870	9913	9957	43
N.	0	1	2	3	4	5	6	7	8	9	D.

EXPLANATIONS OF THE PRECEDING TABLES

TABLE I

THE ATOMIC WEIGHTS OF THE ELEMENTS

This table contains the most recent values of the atomic weights of the elements, based upon the following standards: oxygen = 16.000, silver = 107.87.

There seems to be little doubt now that the atomic weight of silver is at least as low as 107.87, and for that reason all of those values which have been determined by means of silver are recalculated to this basis.

The writer has ventured to give the atomic weights of a few elements to three places of decimals, but it must be remembered that the third place is obtained by averaging a large number of analyses, and, with two exceptions, it is not definitely known. However, in view of the fact that such excellent work has been done in revising the weights in these special cases, it seems probable that the values as recorded approach more closely the true values than would be the case if the third place were dropped.

TABLES II–IV

These tables contain the molecular weights * of common compounds, multiples of the atomic weights of common elements, and of some common compounds.

They are useful in calculating the amounts of substances which are chemically equivalent to given amounts of other substances. A few examples will illustrate some of their uses:

(1) Calculate the weight of hydrochloric acid which is exactly equivalent to 1.5 grams of sodium carbonate.

$$Na_2CO_3 + 2\,HCl = 2\,NaCl + CO_2 + H_2O.$$

$$\text{mol. wt. } Na_2CO_3 : \text{mol. wt. } HCl \times 2 :: 1.5 \text{ grams } Na_2CO_3 : x \text{ grams } HCl.$$

$$\frac{\text{mol. wt. } HCl \times 2 \times 1.5}{\text{mol. wt. } Na_2CO_3} = \text{wt. } HCl \text{ required.}$$

* The accuracy of a molecular weight is largely determined by the least accurate of the atomic weights which make it up. For example, it is useless to give the molecular weight of sulphuric acid to more than two places of decimals, although the atomic weight of hydrogen is known within a few units in the fourth place of decimals, and oxygen is the standard.

log second multiple of the mol. wt. HCl (Table IV)	= 1.862870
log 1.5 (table of logarithms)	= 0.176091
sum	= 2.038961
log mol. wt. Na_2CO_3 (Table III)	= 2.025265
difference	= 0.013696

The number of which 0.013696 is the logarithm is 1.03203, which is the weight of HCl required.

(2) What weight of silver must be dissolved in nitric acid and added to a solution containing two grams of barium chloride in order to precipitate exactly all of the chlorine?

$$BaCl_2 + 2\,AgNO_3 = 2\,AgCl + Ba\,(NO_3)_2.$$

$$\text{mol. wt. } BaCl_2 : \text{at. wt. Ag} \times 2 :: 2 \text{ grams } BaCl_2 : x \text{ grams Ag}.$$

$$\frac{\text{at. wt. Ag} \times 2 \times 2}{\text{mol. wt. } BaCl_2} = \text{wt. Ag required.}$$

log second multiple at. wt. Ag (Table II)	= 2.333930
log 2 (table of logarithms)	= 0.301030
sum	= 2.634960
log mol. wt. $BaCl_2$ (Table III)	= 2.318627
difference	= 0.316333

The number of which 0.316333 is the logarithm is 2.07172, which is the weight of silver required.

(3) The atomic weights of many of the elements are most readily and accurately determined by preparing certain of their halides in a state of great purity, and then in a weighed sample of such material determining the exact weight of pure silver which is equivalent to the halogen. From such data the atomic weight of the element in question may be easily calculated by means of the tables. For example, let us take a special case which will illustrate the method: A weighed sample of phosphorus tribromide was treated in such a manner that the exact weight of silver equivalent to the bromine it contained was determined, and the weight of silver bromide formed was also determined. The atomic weights of bromine and silver being accurately known, we have only to calculate from the data the molecular weight of phosphorus tribromide and subtract from it three times the atomic weight of bromine in order to obtain the atomic weight of phosphorus. Therefore we make the following proportion:

$$\text{wt. Ag} : \text{wt. } PBr_3 :: \text{at. wt. Ag} \times 3 : \text{mol. wt. } PBr_3.$$

In this calculation we need, in addition to the logarithms of the first two terms of the proportion, the logarithm of the third multiple of the atomic weight of silver, and the third multiple of the atomic weight of bromine, both of which are given in Table II.

To calculate the same value from the weight of silver bromide formed, which incidentally serves as a check on the first value and also gives one a clear idea of the purity of the precipitate, we make the following proportion:

$$\text{wt. AgBr} : \text{wt. PBr}_3 :: \text{mol. wt. AgBr} \times 3 : \text{mol. wt. PBr}_3.$$

The third multiple of the molecular weight of silver bromide is given in Table IV.

The tables are also useful in making standard solutions, especially those of certain normalities, as in many cases it is only necessary to shift the decimal point in the proper value in order to ascertain the weight of substance which a liter of the standard solution should contain.

A normal solution contains in a liter of *solution* a gram molecular weight of substance reduced to a univalent basis.

Two examples will serve to indicate the method of using the tables for this purpose.

Note. It is scarcely necessary to call attention to the rule of decimal fractions, i.e. that to divide by 10 is equivalent to moving the decimal point one place to the left in the dividend; that to divide by 100 is equivalent to moving the point two places to the left, etc.

SOLUTIONS OF HYDROCHLORIC ACID OF CERTAIN NORMALITIES

$$N = \text{mol. wt. (Table III)}.$$

$$\frac{N}{2} = \frac{\text{mol. wt.}}{2} \backsimeq \frac{\text{mol. wt.} \times 5}{10} \text{ (Table IV)}.$$

$$\frac{N}{5} = \frac{\text{mol. wt.}}{5} \backsimeq \frac{\text{mol. wt.} \times 2}{10} \text{ (Table IV)}.$$

$$\frac{N}{10} = \frac{\text{mol. wt.}}{10} \text{ (Table III)}.$$

$$\frac{N}{25} = \frac{\text{mol. wt.}}{25} \backsimeq \frac{\text{mol. wt.} \times 4}{100} \text{ (Table IV)}.$$

$$\frac{N}{50} = \frac{\text{mol. wt.}}{50} \backsimeq \frac{\text{mol. wt.} \times 2}{100} \text{ (Table IV)}.$$

$$\frac{N}{100} = \frac{\text{mol. wt.}}{100} \text{ (Table III)}.$$

SOLUTIONS OF SODIUM CARBONATE OF CERTAIN NORMALITIES

$$N = \frac{\text{mol. wt.}}{2} \approx \frac{\text{mol. wt.} \times 5}{10} \text{ (Table IV).}$$

$$\frac{N}{5} = \frac{\text{mol. wt.}}{2 \times 5} \approx \frac{\text{mol. wt.}}{10} \text{ (Table III).}$$

$$\frac{N}{10} = \frac{\text{mol. wt.}}{2 \times 10} \approx \frac{\text{mol. wt.} \times 5}{100} \text{ (Table IV).}$$

$$\frac{N}{25} = \frac{\text{mol. wt.}}{2 \times 25} \approx \frac{\text{mol. wt.} \times 2}{100} \text{ (Table IV).}$$

$$\frac{N}{50} = \frac{\text{mol. wt.}}{2 \times 50} \approx \frac{\text{mol. wt.}}{100} \text{ (Table III).}$$

$$\frac{N}{100} = \frac{\text{mol. wt.}}{2 \times 100} \approx \frac{\text{mol. wt.} \times 5}{1000} \text{ (Table IV).}$$

TABLE V

REDUCTION OF COMPOUNDS FOUND TO CONSTITUENTS SOUGHT BY MULTIPLICATION

This table is intended to aid in calculations connected with the analysis of mineral substances, where it is so frequently necessary to determine a given substance in a state of combination different from that the proportionate amount of which we wish to know. If, for example, we wish to determine the amount of barium a given substance contains, we should probably precipitate it and weigh it as barium sulphate and from this weight calculate the barium as follows:

$$\text{mol. wt. } BaSO_4 : \text{at. wt. Ba} :: \text{wt. } BaSO_4 : \text{wt. Ba.}$$

$$\frac{\text{at. wt. Ba}}{\text{mol. wt. } BaSO_4} \times \text{wt. } BaSO_4 = \text{wt. Ba.}$$

The constituent sought, in this case barium, is given in the first column of the table, and the state of combination in which it is convenient to determine the substance, barium sulphate, is given in the second column. On the same horizontal line with $BaSO_4$ a factor is given which is the quotient resulting from the division of the atomic weight of barium by the molecular weight of barium sulphate, so that it is only necessary to add to the logarithm of this factor the logarithm of the actual weight of barium sulphate in order to obtain the logarithm of the required weight of barium.

From the above it is plain that the factors express the actual weight of substance sought, contained in, or equivalent to one gram of substance found; that is, the first term of the proportion is reduced to unity, the second term

is expressed by the factor, the third term is the weight of substance found. By multiplying the second and third terms together the product expresses the weight of substance sought.

(2) In analyzing orthoclase feldspar the potassium and sodium are separated from the rest of the constituents and weighed together as chlorides. The potassium is then separated from the sodium in the usual manner and weighed as K_2PtCl_6. It is customary to express the results of such analyses in percentages K_2O and Na_2O. From the weight of combined chlorides and the weight of K_2PtCl_6 the weights of K_2O and Na_2O are calculated as follows:

$$\text{mol. wt. } K_2PtCl_6 : \text{chem. equiv. wt. } K_2O :: \text{wt. } K_2PtCl_6 : \text{wt. } K_2O.$$
$$\text{wt. } K_2PtCl_6 \times 0.19383 \text{ (factor)} = \text{wt. } K_2O.$$
$$\text{mol. wt. } K_2PtCl_6 : \text{chem. equiv. wt. KCl (2 KCl)} :: \text{wt. } K_2PtCl_6 : \text{wt. KCl}.$$
$$\text{wt. } K_2PtCl_6 \times 0.30683 \text{ (factor)} = \text{wt. KCl}.$$
$$\text{wt. of combined chlorides} - \text{wt. KCl} = \text{wt. NaCl}.$$
$$\text{chem. equiv. wt. NaCl (2 NaCl)} : \text{mol. wt. } Na_2O :: \text{wt. NaCl} : \text{wt. } Na_2O.$$
$$\text{wt. NaCl} \times 0.53028 \text{ (factor)} = \text{wt. } Na_2O.$$

Calculation of Indirect Analysis

Let us suppose that we have a mixture of a chloride and a bromide, and that we wish to determine the chlorine and the bromine. The weight of silver which is equivalent to the combined halogens is determined by the Volhard method. Then the precipitated AgCl and AgBr are collected and weighed together.

Let $x = \text{wt. AgCl},$

and $y = \text{wt. AgBr}.$

Then $x + y = a \text{ (wt. of AgCl + AgBr)},$

and $\frac{\text{Ag}}{\text{AgCl}} x + \frac{\text{Ag}}{\text{AgBr}} y = b \text{ (wt. Ag equiv. to Cl and Br)}.$

As $\frac{\text{Ag}}{\text{AgCl}}$ and $\frac{\text{Ag}}{\text{AgBr}}$ are constant quantities, we may represent them by k and k' respectively. The equations then become

$$x + y = a,$$
$$kx + k'y = b.$$

Multiplying the first equation by k and subtracting the second from it in order to eliminate x, we have

$$kx + ky = ka,$$
$$kx + k'y = b,$$
$$(k - k')\,y = ka - b,$$
$$y = \frac{ka - b}{k - k'}.$$

As $k - k'$ is a single constant we have $y = \frac{ka - b}{K}\cdot$ By substituting the value thus obtained for y in the first equation we have $x = a -$ value of y.

$$\text{wt. AgCl} \times 0.24737 = \text{wt. Cl.}$$
$$\text{wt. AgBr} \times 0.42555 = \text{wt. Br.}$$

The values of $\frac{Ag}{AgBr}$ and $\frac{Ag}{AgCl}$ are given in Table V under Ag and opposite AgBr and AgCl respectively.

TABLES VI–IX

Normal atmospheric pressure is equal to the pressure exerted at sea level and 45° latitude by a vertical column of pure mercury 760 mm. long, the temperature of which is zero degrees C.

Barometric readings made under ordinary conditions must be reduced to standard conditions; that is, corrections must be applied for temperature, latitude, and elevation.

Temperature corrections. In view of the fact that the cubical expansion of mercury is much greater than that of glass, and the length of the barometer scale also changes with the temperature, it is necessary to consider all of these factors in making the temperature corrections. However, these have been combined and the values are given in Table VI.

Latitude corrections. Gravity at 45° latitude and sea level is considered normal. The values of this force in other latitudes as compared with the normal, taken as unity, are given in Table VII for a few important places. The length a barometric column of any latitude would have if it were acted upon by normal gravity may be calculated by multiplying the observed reading by that fraction which the force of gravity at the latitude in question is of normal gravity, or the proper correction may be taken from Table VIII, A.

Elevation corrections. These are necessary, because gravity diminishes as we proceed from the center of gravity of the earth (Table VIII, B).

Capillary depression corrections. Manufacturers of straight barometers make due allowance, in the adjustment of the scale, for capillary depression of the mercury; and in U-shaped barometers and manometers the forces on the two surfaces compensate, provided the mercury is of uniform purity and the arms are of the same diameter. However, there are other purposes for which the values of the capillary depression of mercury may be needed, and they are given in Table IX.

TABLES XII AND XIII

REDUCTION OF GAS VOLUMES TO NORMAL CONDITIONS OF PRESSURE AND TEMPERATURE

Boyle's Law. The volume of a given mass of any gas varies inversely as the pressure upon it, provided the temperature remains constant.

If v represents the volume of a given mass of gas at 760 mm. pressure, and v_1 any other volume of the same mass at the pressure h, then $760\,v = hv_1$, and $v = \frac{h}{760} v_1$.

In order to calculate the volume any given amount of gas would have if it existed under normal pressure, we have only to add to the logarithm of the observed volume the logarithm of the value of $\frac{h}{760}$, taken from Table XII. The sum will be the logarithm of the required volume.

Moist gases are assisted in sustaining the pressure of the atmosphere by the partial pressure of water vapor. Therefore, in order to find the pressure which the gas itself is actually exerting (which is equal to the pressure under which it exists in equilibrium), we must subtract from the pressure of the atmosphere the aqueous tension.

If the volume of a gas cannot be measured under exactly atmospheric pressure, it is frequently convenient to determine its pressure by measuring the difference between it and that of the atmosphere by means of an open arm manometer. The pressure of the atmosphere is then altered by the amount of this difference in order to ascertain the pressure under which the gas exists. The pressure which the gas alone exerts is represented by h of Table XII.

Charles's Law. The volume of any gas increases by $\frac{1}{273}$ part of its volume at 0° C. for every degree its temperature increases.

If V_t is the volume of a gas at the temperature t, we have

$$V_t = V_0 + V_0 \times 0.00367\,t = V_0(1 + 0.00367\,t); \text{ then } V_0 = \frac{1}{1 + 0.00367\,t} \times V_t.$$

The values of $\frac{1}{1 + 0.00367\,t}$ are given in Table XIII for temperatures ranging from 0° to 149°.

To calculate the volume a given amount of gas would have if its temperature were reduced to zero, we have to add to the logarithm of the observed

volume the logarithm of the value of $\frac{1}{1 + 0.00367\,t}$ (Table XIII). The sum will be the logarithm of the required volume.

We may combine the expressions given above if we wish, as is usually the case, to reduce the volume to standard conditions of both pressure and temperature, thus

$$V_{0^\circ,\,760\,\text{mm.}} = \frac{h}{760} \times \frac{1}{1 + 0.00367\,t} \times V_{t^\circ,\,h\,\text{mm.}}$$

These reductions may be summed up as follows: Correct the barometric reading for temperature, latitude, and elevation. Subtract from the corrected reading the tension of aqueous vapor, and apply the manometer correction, if there be one. The result is the value represented by h. Add to the logarithm of the observed volume, the logarithm of $\frac{h}{760}$ (Table XII) and of $\frac{1}{1 + 0.00367\,t}$ (Table XIII). The sum will be the logarithm of the required volume.

TABLE XIV

This table is intended to minimize the labor of reducing the volume of moist gases to normal conditions and dry. It is assumed that the temperature of the barometer and of the gas and water over which the gas is measured is the same. Under this condition the barometric reading is corrected for temperature, the tension of aqueous vapor subtracted, and the resulting value of $\frac{h}{760}$ combined with $\frac{1}{1 + 0.00367\,t}$ for certain combinations of temperature and pressure.

Take from the table the logarithm corresponding to the temperature and approximate pressure. Interpolate to find the logarithm corresponding to the exact pressure, and add to it the logarithm of the observed volume of the gas. The sum will be the logarithm of the volume under normal conditions and dry.

TABLE XV

If one wishes to know the weight of an observed volume of gas, as in the analysis of nitrogenous organic substances by the Dumas method, the volume should be reduced to standard conditions, and then to the logarithm of this volume add the logarithm of the weight of one liter of the gas, taking care to express the volume read off as a fraction of a liter.

TABLE XXVIII

BUOYANCY OF AIR

In view of the fact that the buoyant effect of the atmosphere changes considerably and often rapidly, it is necessary in work where great accuracy is required to reduce the apparent weight of a substance to a vacuum standard.

If d is the weight of 1 cc. of air and v the volume of the object weighed, the true weight is $w + vd$, where w is the apparent weight.

If the specific gravity of the substance is known, its volume is calculated by dividing its weight by the specific gravity. The error introduced by using the apparent weight instead of the true weight in the expression $v = \frac{w}{s}$ is negligible. Therefore the true weight of a substance is $w + \frac{w}{s} d$.

If we wish to obtain absolute weighings, the same kind of correction must be applied to the weights. For brass weights ($s = 8.3$) the correction is 0.000145 per gram. This correction is negative and is to be subtracted from the calculated true weight of the substance.

The true, absolute weight, then, of a substance weighed in air with brass weights is $w_0 = w\left(1 + \frac{d}{s} - 0.000145\right)$.

The values of d (Table XVI) are calculated for 760 mm. pressure. In work where the greatest accuracy possible is required, the value of d must be reduced to the existing condition of pressure; namely, $d \times \frac{h}{760}$.

In many instances, however, it is sufficiently accurate to consider d constant and equal to 0.0012 g. at room temperature. Under this condition the above expression becomes

$$w_0 = w\left(1 + \frac{0.0012}{s} - 0.000145\right) = w(1 + c). \quad \text{(See Table XXVIII.)}$$

THE COMMON SYSTEM OF LOGARITHMS

This system of logarithms is in general use because it greatly abridges numerical computation, and with due care arithmetical errors are largely eliminated.

The logarithm of a number is the exponent of the power to which it is necessary to raise a fixed number, in order to produce the first number.*

* The definition is based upon the assumption that there always exists a real number x which satisfies the equation $b^x = a$, where a and b are positive numbers and b is greater than 1.

The base of the common system is 10, and since

$$10^0 = 1 \qquad 10^{-1} = 0.1$$
$$10^1 = 10 \qquad 10^{-2} = 0.01$$
$$10^2 = 100 \qquad 10^{-3} = 0.001$$
$$10^3 = 1000 \qquad 10^{-4} = 0.0001$$

it follows from the definition of a logarithm that

$$\log 1 = 0 \qquad \log 0.1 = -1$$
$$\log 10 = 1 \qquad \log 0.01 = -2$$
$$\log 100 = 2 \qquad \log 0.001 = -3$$
$$\log 1000 = 3 \qquad \log 0.0001 = -4$$

It is quite evident from the above table that the logarithms of all numbers between 0 and 1 are negative and that the logarithms of all numbers greater than 1 are positive.

NOTE. A negative number is considered as having no logarithm.

We see also that the logarithm of any number between 1 and 10 is greater than 0 and less than 1; thus

$$\log 2.71 = 0.432969.$$

The logarithm of any number greater than 10 and less than 100 is greater than 1 and less than 2; thus

$$\log 26. = 1.414973.$$

It is plain that if a number is not an exact power of 10, its logarithm must consist at least in part of a decimal fraction.

It is true that such logarithms can be expressed only approximately, but if the fractions are given to six places, they are sufficiently accurate for even the best atomic weight work.

The integral part of a logarithm is called the characteristic, and the decimal part the mantissa. In the case just given 1 is the characteristic and .414973 the mantissa of the log 26.

To find the characteristic of the logarithm of a number:

(*a*) When the number is greater than unity, the characteristic of its logarithm is one less than the number of digits to the left of the decimal point. Thus the characteristic of the logarithm of 46783.85 is 4.

(*b*) When the number is less than unity, subtract from 9 the number of ciphers between the decimal point and the first significant figure, writing -10 after the mantissa. Thus the characteristic of the logarithm of 0.00089 is 6 with -10 written after the mantissa: $\log 0.00089 = 6.949390 - 10$.

Some prefer to combine the two parts of such characteristics, writing the result as a negative characteristic, in which case it is one greater than the number of zeros preceding the first significant figure. The minus sign is written above the characteristic to show it applies only to it, for in constructing logarithmic tables it is convenient to make all mantissas positive even if the logarithm is a negative number. For example, $\log \frac{1}{4} = -0.602060$; but since $-.602060 = -1. + .397940$, this may be written $\log \frac{1}{4} = \bar{1}.397940$ or $9.397940 - 10$ with a positive mantissa. In order to avoid complications it is best to adhere to the first form of expression mentioned under (*b*); that is, when a logarithm has a negative characteristic to add 10 to and subtract 10 from it. For example, instead of writing the logarithm $-1. + .397940$, or $\bar{1}.397940$, we should write $+10 - 1. + .397940 - 10 = 9.397940 - 10$. This is convenient when we wish to divide a logarithm by a number. Since mantissas are always positive, it would not be correct to divide $\bar{1}.397940$ by 2, as we should confuse the positive and negative parts. If the form $9.397940 - 10$ is used, the confusion is avoided, and the result of the division by 2 is $4.698970 - 5 = \bar{1}.698970$, the actual logarithm resulting from the division.

TABLE OF LOGARITHMS

The great value of the common system of logarithms for the purposes of the analytical chemist is due to the fact that short tables can be constructed which contain the mantissas of the logarithms of all numbers from 1 or 100 to some given number, generally 1000 or 10,000, this being sufficient to cover all cases, and the characteristics can be determined by inspection.

In order to use a table of logarithms one must know how to find the logarithm of any number, and how to take from the table the number which has a given logarithm, and also how to point the numbers off.

To find from the table the logarithm of any number:

(*a*) When the number consists of two significant figures.

All of these numbers are given on the first page of the table in columns marked *N*. The logarithm of each number is placed opposite the number.

(*b*) When the number consists of three or four significant figures.

Find in the column of numbers the first three significant figures of the given number, then glance across the page along a horizontal line to the column under the fourth figure of the given number; four figures of the required mantissa are given at this point, to which two figures taken from the zero column must be prefixed. If the four figures of the required mantissa are

opposite a row of six figures in the zero column, the first two of the six are to be prefixed; but if they are opposite only four figures in the zero column, the two figures to be prefixed will be found above, unless in passing back to the zero column asterisks be met with, in which case the two figures will be found immediately below the horizontal line in the zero column. Zeros should be written wherever asterisks occur. Characteristics are then prefixed in accordance with the rules already given.

Examples: $\log 106 = 2.025306$
$\log 1264 = 3.101747$
$\log 2041 = 3.309843$
$\log 2042 = 3.310056$
$\log 2048 = 3.311330$

(*c*) When the number consists of more than four significant figures.

The mantissas of the logarithms of these numbers are not to be found in the table, but they can be easily calculated from values given in the table by a process of interpolation. The principle of proportional parts assumes that for a small change in a number there corresponds a proportional change in the logarithm. This is not strictly true, but the approximation is sufficiently close for most purposes.

For example, required the log 521257. We find from the table $\log 5212 = 3.717004$ and $\log 5213 = 3.717088$. That is, an increase of one unit in the fourth figure produces an increase of .000084 in the logarithm. Therefore an increase of .57 of this unit will produce an increase in the logarithm equal to $.57 \times .000084$, or .000048. Hence $\log 521257 = 5.717052$.

Note. In order to facilitate the process of interpolation it is customary to give the differences between the logarithms of consecutive numbers of four figures in a separate column. Such numbers are called tabular differences. In the table one number is given at the end of each horizontal line, and in each case it is nearly a mean of the differences of any two logarithms on the same line. It is intended that these numbers should serve only as a guide, and the last figure should be checked in every instance by glancing at the logarithms involved.

The following rule is derived from the above: Place a decimal point after the fourth significant figure from the left, converting the given number into a whole number and a fraction, and this irrespective of any decimal point that may occur in the given number.* Find from the table the mantissa

* Numbers with the same sequence of figures and which differ only in the position of the decimal point have the same mantissa, for one is the product of the other and an integral power of 10; hence their logarithms differ only by integers. Therefore the mantissa of the common logarithm of a number is independent of the decimal point.

of the entire part and multiply the decimal part by the tabular difference; add the product thus obtained to the mantissa of the entire part and prefix the proper characteristic, determined with respect to the position of decimal point in the original number.

To find from the table the number which corresponds to a given logarithm:

(*a*) Required the number the logarithm of which is 1.874772. We find this exact mantissa given in the table, and opposite in the column of numbers we find 749, the first three figures of the required number, and at the head of the column 5 the fourth figure.

(*b*) Required the number the logarithm of which is 2.137860. The mantissa of this logarithm is not given in the table, but it lies between the two mantissas .137671 and .137987, and the numbers corresponding to these are 1373 and 1374 respectively. The difference between the two mantissas taken from the table is 316, and the difference between the given mantissa and the smaller of the two taken from the table is 189; that is, an increase of 316 in the mantissa produces an increase of one unit in the corresponding number. Therefore an increase of 189 in the smaller of the two mantissas taken from the table will produce an increase of $\frac{189}{316}$ of a unit in the corresponding number. Hence the required number is 137.359 nearly.

The following rule is derived from the above:

Search in the table for the mantissa of the given logarithm, and if it cannot be found, set aside the number corresponding to the next less mantissa. Subtract this mantissa from that of the given logarithm and divide the remainder by the tabular difference, carrying the division as far as desirable. Annex the quotient to the number set aside, and point off from the left one more integer figure than there are units in the characteristic of the given logarithm. If the characteristic is negative, the number is less than 1, and the number of zeros to be placed before the first figure is one less than the number of units in the characteristic.

MULTIPLICATION BY LOGARITHMS

Find from the table the logarithms of all the numbers to be multiplied together. Add these algebraically, remembering that negative signs apply only to the characteristic. The sum is the logarithm of the product.

Thus multiply 27.1 by 119.86.

$$\begin{aligned} \log 27.1 &= 1.432969 \\ \log 119.86 &= \underline{2.078674} \\ &\ 3.511643 = \text{log of product} \end{aligned}$$

The number of which this is the logarithm is 3248.201.

Division by Logarithms

Find the logarithm of the dividend and subtract from it the logarithm of the divisor. The difference is the logarithm of the quotient. The word "difference" is used here in its algebraic sense. That is, if the characteristic of the logarithm of the divisor is negative, its sign must be changed; but if that of the dividend is negative, it must be treated as a negative quantity. Let it be said once more that mantissas without exception are positive.

1. To divide 100.07 by 56.07.

$$\begin{array}{rl} \log 100.07 = & 2.000304 \\ \log 56.07 = & \underline{1.748731} \\ & 0.251573 = \text{log of quotient} \end{array}$$

The number of which this is the logarithm is 1.78473.

2. To divide 107.87 by 0.0187779.

$$\begin{array}{rl} \log 107.87 = & 2.032901 \\ \log 0.0187779 = & \underline{\bar{2}.273647} \\ & 3.759254 = \text{log of quotient} \end{array}$$

The number of which this is the logarithm is 5744.5.

3. To divide 0.13736 by 153.36.

$$\begin{array}{rl} \log 0.13736 = & \bar{1}.137860 \\ \log 153.36 = & \underline{2.185712} \\ & \bar{4}.952148 = \text{log of quotient} \end{array}$$

The number of which this is the logarithm is .00089568.

In regard to involution and evolution it is only necessary to say that the logarithm of any power of a number is obtained by multiplying the logarithm of the number by the exponent of the power, and that the logarithm of any root of a number is obtained by dividing the logarithm of the number by the index of the root.